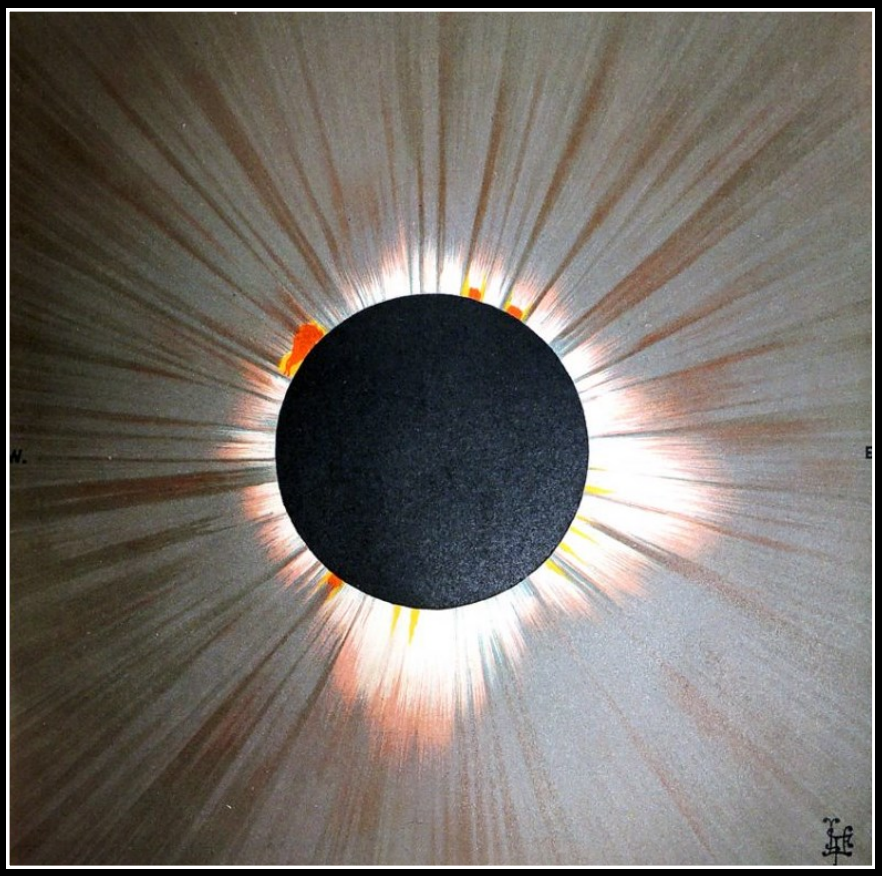
ISSN 1059-1249

The Magic Lantern Gazette

A Journal of Research

Volume 30, Number 3-4 Fall/Winter 2018



The Magic Lantern Society of
the United States and Canada

www.magiclanternsociety.org

The Fall issue of the *Gazette* has turned into the Fall/Winter double issue. At 32 pages, it is twice the minimum number of pages I aim for in an issue. Because I had to write much of the material myself, it took longer than usual to complete, so a double issue puts the journal back on schedule. Also, I currently have no articles submitted for the next issue, so making that the Spring issue gives me more time.

This issue includes two major feature articles on magic lantern research. The longer one is my own article on Henry Morton, who was known as the Prince of American scientific lecturers because of the spectacular effects he achieved in illustrated popular science lectures in the 1860s and 1870s. His lectures included magic lantern effects, such as a re-creation of the phantasmagoria shows that had been popular in the United States decades earlier, as well as dramatic experiments with various sources of light and electrical instruments.

Morton also was a life-long advocate for the use of the magic lantern in science education in schools and colleges in the period after the Civil War, which marked the beginning of serious science education in America. He designed his own version of a vertical lantern, which allowed for projection of experiments performed on a horizontal platform. The commercial version of this lantern was widely adopted by colleges across the nation. Morton also interacted with and sometimes assisted other lantern lecturers, including visiting foreigners such as John Tyndall, John Henry Pepper, and Richard Proctor. Jeremy Brooker has previously written on the relationship between Morton, Tyndall, and Pepper, so I have mentioned that only briefly in my article.

The second feature article is Suzanne Wray's fascinating piece on the Electric Cyclorama of Charles A. Chase, an American showman who attempted to replicate the effect of stationary circular panoramas by using multiple magic lanterns to project images on a circular screen.

There also are several summaries of academic research articles and book chapters on magic lantern related topics in The Research Page. Finally, there is a brief review of a new book that looks at the actual and metaphorical use of the magic lantern and other optical devices in Victorian Britain.

I close by issuing my usual plea for more material for the *Gazette*. There were few submissions in 2018, following a pretty active 2017. I encourage anyone doing research on magic lanterns and related topics to submit articles to the *Gazette*, which can accommodate anything from three or four pages to 30 pages or more.

Kentwood D. Wells, Editor
451 Middle Turnpike
Storrs, CT 06268
kentwood.wells@uconn.edu
860-429-7458

Henry Morton burning a steel sword with an oxyhydrogen blowpipe in one of his lectures on "Light."

Henry Morton: Prince of American Lecturers on Science

Kentwood D. Wells
451 Middle Turnpike
Storrs CT 06268
kentwood.wells@uconn.edu

In September 1874, the Philadelphia firm of Benerman & Wilson, a dealer in magic lanterns and photographic equipment, and publisher of books and periodicals on photography, inaugurated a small monthly periodical called *The Magic Lantern*. This publication was designed as a trade magazine for magic lantern exhibitors, with short articles by experts on magic lantern practice and equipment. The prospectus published in the first issue stated that, "In this work we will be assisted by Prof. Henry Morton, Ph.D., the prince of American lecturers on science."[1] Morton was, in fact, an American pioneer in the use of the magic lantern to produce spectacular effects in popular science lectures, as well as a strong advocate for the use of the magic lantern in scientific instruction in schools and colleges.[2]

Henry Jackson Morton (1836-1902) (Fig. 1) was born in New York City. As an undergraduate at the University of Pennsylvania, he distinguised himself by publishing a translation of the Rosetta stone as a sumptuously illustrated book. Because of the high cost of publishing the volume with color illustrations, he taught himself lithography and prepared his own drawings on stone. This project marked the beginning of a life-long interest in Egyptology. Despite receiving relatively little training in science at the university, which was fairly typical at the time, he volunteered to lecture on physics and chemistry at the Episcopal Academy of Philadelphia shortly after graduating in 1857. By 1863, at age 27, Morton was appointed Professor of Chemistry at the Philadelphia Dental College, of which he was a founder. Five years later, he was appointed Professor of Chemistry at the University of Pennsylvania. Only two years after that, at age 34, he became the first president of Stevens Institute of Technology in Hoboken, New Jersey and remained in that post for the rest of his life.[3]

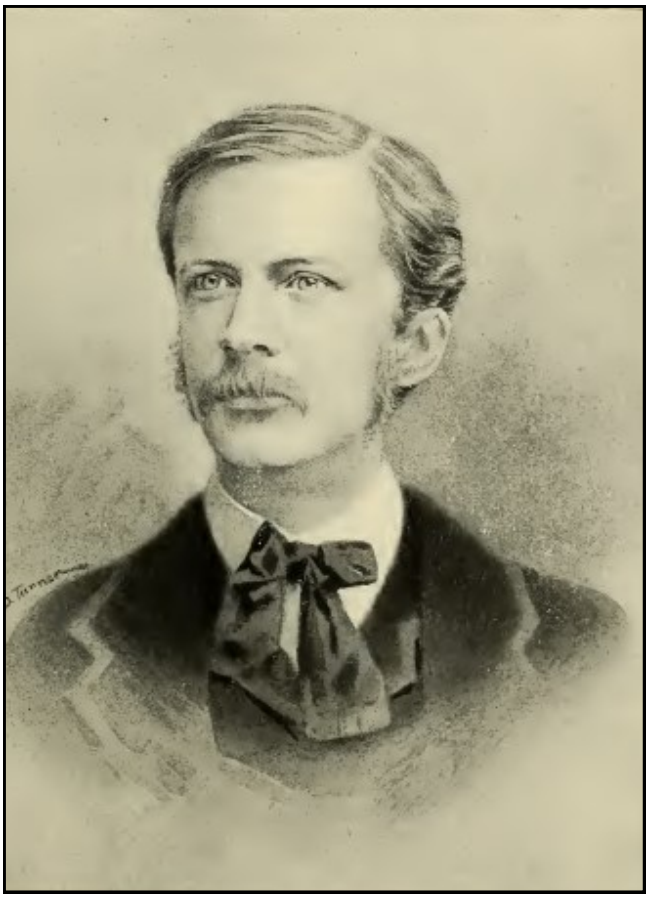


Fig. 1. Henry Jackson Morton in 1864. From Sellers and Leeds (1892).

Morton's Philadelphia Lectures

Morton's first public lectures with the magic lantern probably were given in his capacity as lecturer in natural philosophy at the Episcopal Academy at 1314 Locust St. According to a memoir published by the National Academy of Sciences, his lectures were so entertaining, and "the illustrations so brilliant," that the school lecture room was soon overflowing with listeners. In fact, a new lecture hall had to be built to accommodate pupils from other schools and members of the public who flocked to Morton's evening lectures.[4] Morton continued to lecture at the Episcopal Academy at least until 1865, even after he had been appointed to other academic positions. A Philadelphia newspaper described a demonstration given to an invited audience of "professional men" at the science laboratory of the Episcopal Academy in April 1865, in which a magic lantern was used with carbon arc and limelight illumination, not to project lantern slides, but to produce spectacular light effects:

The first exhibition was of the heating effect of the galvanic current when applied to a wire several feet in length, suspended between two metallic columns. In an instant the arching wire blazed forth with brilliancy quite dazzling, and reminded one of Mahomet's bridge cast over the profound abyss of the nether world. The bridge burned like the bush of Moses, but, like it, was not consumed. The wire sufficed to conduct the current without being melted or dissipated.

The galvanic current was then caused to pass (by wires previously laid) to the rear of the room, where was arranged a large lantern, in the focus of whose lens the electric fluid was caused to pass between two carbon points, the image of these points and of the electric fire being projected on a vast screen at the opposite extemity of the audience chamber. The effect was magical. Two huge cones, like those of Ætna and Vesuvius, were seen approaching each other blazing with intense light and heat. As they threatened each other in this antagonism, sheet-lightning seemed to play over their brilliant cones, throbbing and pulsating as when on summer nights the distant horizon flickers with the flash of storms too remote to send us the sounds of their tumult. Gradually these cones would melt away, and then suddenly rush together with a clash and renewed fury of fire. We found, from the lecturer, that this motion of the cones or carbon points was effected by a self-adjusting apparatus familiar to scientific men as the 'Electric Lamp of Duboscq' [Fig. 2].

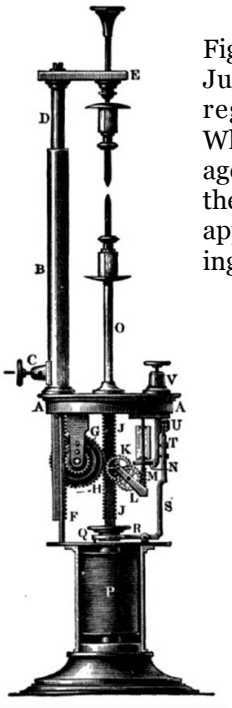


Fig. 2. The electric arc lamp of Jules Duboscq with self-regulating carbon points. When Morton projected an image of the two carbon points, they resembled two volcanos approaching each other, spewing fire. *Wikimedia.*

After these and other experiments with the galvanic battery, the lime light was introduced into the lantern.

In this case the light is produced by causing an ignited jet of mingled oxygen and hydrogen gases to impinge upon a plate of lime, which, becoming intensely heated, emits a white light of dazzling intensity. This apparatus was used to demonstrate various facts with regard to the composition of light, among other experiments for the production of an artificial rainbow. The gurgling sound of the gas rushing through a vessel of water in one part of the apparatus, formed no inapt suggestion of falling showers and overflowing brooks, when suddenly there swept across the whole expanse of the screen, running out beyond it to the extreme corners of the lecture-room, a superb bow, exceeding in brilliancy of color all natural bows that we have ever seen in the sky. Indeed, the glow of color was so intense that it required the turning on of several gas-lights in the room to reduce it to the ordinary lustre of a natural rainbow. Nothing can be imagined more brilliantly successful than this display; and the subsequent exhibitions of polarized light, beautiful as they were, seemed lost in the previous splendor of this wonderful production.[5]

Morton's demonstration to a limited audience at the Episcopal Academy turned out to be a preview of his series of lectures on light, sponsored by the Franklin Institute and delivered at the Philadelphia Academy of Music, two blocks down Locust Street from the Episcopal Academy. The same newspaper account reported that "these and other experiments are to be exhibited to the public on next Tuesday evening at the Academy of Music."[6]

Morton's association with the Franklin Institute in Philadelphia solidified his reputation as a popular science lecturer. The Franklin Institute (Fig. 3) was founded in 1824 as the Franklin Institute of Pennsylvania for the Promotion of the Mechanic Arts. The goal of the institute was to foster research and education in science and its practical applications, at a time when scientific subjects were largely absent from school and college curricula. After several decades of useful contributions to science education, the Franklin Institute had, by the 1860s, "lapsed into a decrepit state; running in time-worn ruts, its library antiquated and little used, its lectures and meetings sparsely attended."[7]

Fig. 3. The original building of the Franklin Institute, now the Philadelphia History Museum.

Wikimedia Commons.

This began to change when Morton became Resident Secretary of the Franklin Institute in 1864 and editor of its journal in 1867. He quickly set about improving the fortunes of the Institute, in part by developing a series of lectures that would attract a large paying audience. His first lecture, on behalf of the Franklin Institute, was delivered at the Philadelphia Academy of Music on May 2, 1865. The auditorium was "well filled" with "an appreciative audience," so much so that Morton repeated the lecture a week later, on May 9, with some modifications. The *Philadelphia Inquirer* provided a detailed description of the May 9 version of the lecture, which focused the theory of light and methods of producing light:

> The lecturer here showed a disc of soft iron at one side of the stage, which received motion from a steam engine placed below, and it was running at the enormous velocity of six thousand times a minute. Its edge, though smooth to the eye, revealed to the microscope countless serrations. . . . The end of a flat file was then pressed upon the disc, when a blaze of white flame shot out from the point of contact, and a shower of sparks was projected into the air.

Morton went on to repeat the experiments exhibited at the Episcopal Academy, including a demonstration of limelight, the "volcano" effect produced by a carbon arc lamp, and creation of an artificial rainbow, all using a magic lantern to project the experiments on a screen:

> The lime light was exhibited, where the vibrations generated by the union of oxygen and hydrogen gases being "resounded" (so to speak) from a block of lime, filled the whole house with light so intense as to *throw a shadow* from the ordinary gas flame [of the house lights].
>
> The production of light by galvanic force was then demonstrated in various ways, most strikingly by the electric light. Here the force generated in a powerful galvanic battery is carried through wires to two carbon points arranged in a lantern. This electric or galvanic power there tears off particles of carbon from one point, and hurls them upon the other, and in so doing, as might be expected, generates in the points intense and energetic light vibrations. The whole of this process was beautifully exhibited by making the points paint their own image immensely magnified on a screen. . . .
>
> [The composition of white light] may be shown by breaking a ray of white light into all the prismatic colors. The lecturer here exhibited this fact in such a way as to not only give a full demonstration in a philosophical sense of the point of view, but added to this the pleasure of one of the most beautiful scenes with which nature or art can delight us. He made *an artificial rainbow*.
>
> The scenery of the stage having been shifted so as to represent a forest glade, backed by mountains, overhung by a cloudy grey sky, an arch of white light first shown was spread into a rainbow, and flung across the sky, resting, as it seemed, upon the distant hills.[8]

Morton's second lecture in his series on "Light" was delivered at the Academy of Music on November 29, 1865. This lecture focused on "Shadows" and was described in the local paper in a story with no less than seven headlines: **Science, A Rare Treat at the Academy, Professor's Morton's Lecture on Shadows, The Universe as an Example, Splendid Illustrative Apparatus, Curious and Amusing Scientific Effects, Entire Success of the Second Lecture.**

One shadow effect demonstrated was an eclipse of the moon, when the earth's shadow blocks sunlight from reaching the moon:

> Professor Morton, then, by the aid of diagrams thrown upon the immense transparent screen used on the occasion, explained the actions of light concerned in a lunar eclipse. Then, at a signal, the white screen was raised,

> disclosing a distant expanse of cloud-flecked blue sky, across which sailed a large figure of the earth, six feet in diameter, upon which an electric light, within a transparent globe, representing the sun, poured a flood of radiance; beyond this earth, lost in its shadow and now reappearing in the light, sailed a miniature moon, representing the various actions of an eclipse.

Morton then went on to illustrate changes in the size of shadows with changing distance from a light source, with live actors performing a shadow play, using techniques borrowed from the phantasmagoria:

> An electric lamp being placed at the rear of the stage, and the Professor's assistants going through various motions at different distances, their shadows, with a sharpness and clear outline that gave a wonderful idea of reality to all that was seen, performed actions of the most amusing and curious character. Thus a giant and a dwarf entered into an absurdly unequal combat, the former standing forty feet high, the latter hardly five; but at last the dwarf seizes a chair, brings it to the scene of combat, mounts into it, and having thus secured the requisite elevation, fells his huge antagonist at a blow. A colossal hand is stretched across the stage, seizes a group of moving pygmy figures and sweeps them out of sight. One after another, figures, seemingly from a great distance, run across the stage from side to side, approaching the audience, until, just as they seem to touch the curtain, with a leap of unaccountable magnitude they disappear into the ceiling. . . .
>
> After explaining in a complete manner how these effects were produced, Professor Morton next mentioned that the curious arrangement known as the "phantasmagoria" depended upon a similar action of diverging or expanding light was for its peculiar effect.
>
> "Here images are projected from a magic lantern placed behind a translucent screen. The waves or rays that produce these images proceed in expanding cones from the object glass of the lantern. If this lantern is near the screen, the cone is intersected near its summit or apex, where its area is small, and a small image is produced. When, however, the lantern is drawn back, the light rays have opportunity to spread further before reaching the screen, or in other words, the cone of light is cut at a wider portion, and a larger image is produced."
>
> "Mounting, therefore, the lantern and its apparatus on a truck or car and running it smoothly back, the image first seen at a small size, and thus appearing to be at a great distance, enlarges and thus is thought to advance, and to those before the curtain, viewing the effect only, and not its cause, the delusion is perfect, and in this case, beautiful statues, first seen in the dim distance, slide silently forward until they tower in colossal bulk over the parquet, and almost make one shrink back in fear lest they should topple over upon the crowd of spectators" [Fig. 4].

Fig. 4. By using rear-screen projection and moving a magic lantern backwards from the screen, Morton produced effects like sculptures and statues zooming toward the audience, as in a phantasmagoria show.

Wells collection

> A number of statues were then caused, in this manner, to march forward and retreat, so also a colossal skull and many curious devices of huge colored balls, &c.

Morton then proceeded to demonstrate that light beams aimed at an object from different directions do not interfere with one another, but generate independent shadows or images:

> "To demonstrate the non-interference of light waves from various sources under ordinary conditions, I have prepared a solid screen across the stage, having no opening in it except for one place, where it is cut out in the form of a phantom-like figure. Behind this will be produced many lights in different positions; each will send its waves through this one opening, and each will thus project a luminous copy of the open figure on the white screen in front, each body of waves passing through on its own road without the least interference, although all go out through the same door."

The experiment here explained was then shown. First, a colossal figure of an angel, in pure white light, flashed upon the screen; then at one side appeared another, a duplicate of the first, painted with crimson light; then another, until the screen was covered with these luminous phantoms.

The Professor then proceeded to explain another mode of illustrating the same fact, most ingenious in its arrangements and curious in its results: "Suppose two lights, one green, one red, to be burning behind an opaque object at some distance from a screen. Wherever both lights fall and commingle, they will produce a white light. In some place, however, the solid object will intersect the red light and produce a shadow from its rays; but into this space the green rays coming from a different direction will penetrate it and illuminate it with green light, so making a *green shadow*."

"On the other hand, the red rays entering the space protected from the green, will make *that shadow* red. We will thus have the same object casting at once two shadow of different colors."
This experiment was then performed with the most wonderful success. A red and green shadow appeared upon the screen, identical in every form and motion. These two shadows quarreled, were reconciled, shook hands, and collapsed into one, with an effect at once surprising and humorous in a notable degree.[9]

The ostensible topic of Morton's third Academy of Music lecture, on February 16, 1866, was "Refraction, or Prisms and Lenses," but the title did not fully convey the type of visual spectacle presented. At one point in the lecture, Morton inserted a tank of water into his magic lantern and introduced some fishes and other animals that were magnified to a gigantic size on the screen (Fig. 5). One newspaper gave a dramatic description of the effect:

Introducing a tank of water, in which the lecturer informed his audience were some small fish, we were startled by seeing on the screen what seemed to be a huge alligator, a sea serpent, and some nondescript creatures that might be Behemoths, or antediluvian pre-Adamic monsters. The wild struggles of these strange gigantic shapes, as they sought to dive down out of sight, were very exciting. The fish, apparently a good-sized sperm whale, took things more calmly—quietly feeding on the weeds which draped the tank, and justified the declaration of the lecturer that "the exposure did not hurt them." We saw these fellows after the lecture, and were astonished to find that Behemoth was a small crawfish, the sea-serpent a lively little eel, and the sperm whale a very minute specimen of the sunfish.[10]

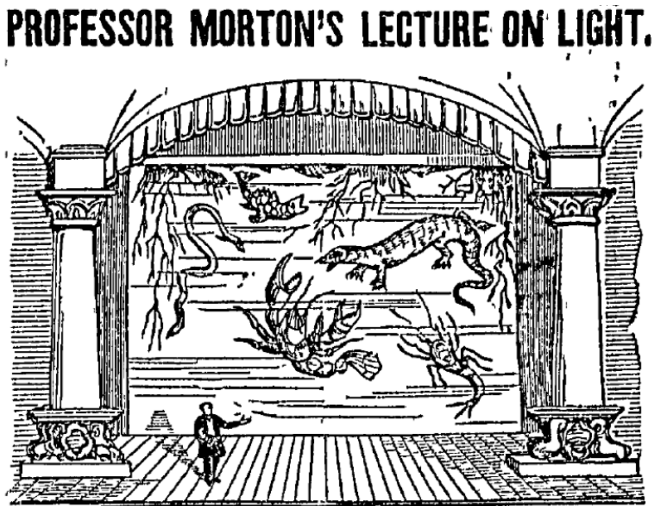


Fig. 5. Prof. Morton using a water tank to project gigantic images of aquatic creatures on the screen. Like most such illustrations, this image is biologically incorrect, combining marine, freshwater, and terrestrial animals (a lizard) that do not live together.

Philadelphia Inquirer, February 17, 1866, p. 1.

In that same lecture, Morton exhibited a variety of magic lantern effects using the phantasmagoria-like rear screen projection introduced in his previous lecture. Among other things, the gigantic skull and statuary reappeared:

Passing behind the stage, we saw a car load of lanterns, lenses, slides and other apparatus, and gas bags in such profusion that it looked like a preparation of mattresses to accommodate a large sleeping party, away from home beyond "lock up time."

The beauty of the experiments was a further feature of the evening. Nothing could surpass the brilliancy of the diagrams, *spectra* and dissolving views. Their succession, too, was very happy. An ominous skull of gigantic size glared out on the audience, and then died slowly away, changing imperceptibly into a face of singular beauty floating along in the clouds. A dark cave dimmed, and as it grew more, and more indistinct, an exquisite statue of Parian marble filled its place and seemed to have been its invisible occupant.[11]

Morton used limelight to project a spectrum through a prism onto the screen, demonstrating the decomposition of white light into its constituent colors. When a glass rod was substituted for the lime, the light produced by the oxyhydrogen flame was yellow, and the full spectrum on the screen was replaced by a single yellow band. Flames of other colors were produced by burning lamp wicks soaked in solutions of various chemicals.[12]

In addition to Morton's Academy of Music lectures, he also participated in an annual series of public lectures given by several scientists in the lecture hall of the Franklin Institute itself. Sometimes the topics of these lectures overlapped with those given at the Academy, but he also covered other topics. For example, in October 1865, the Institute announced a 20-week course of lectures, with Morton covering Mechanics on Tuesday evenings and Albert R. Leeds covering Chemistry on Thursday evenings.[13] The 22-week course announced in November 1866 had more lecturers, with four lectures on Electricity and Light by Morton, seven on Pneumatic Chemistry by Dr. L. J. Deal, three on Chemistry of Metals by Prof. A. R. Leeds, and eight on First Principles of Mechanics by Morton.[14] The number of lecturers expanded even more by November 1867, with the season including lectures on Light by Morton, Electricity by Prof. R. E. Rogers, Astronomy by Pliny E. Chase, Pneumatic Chemistry by Theodore D. Rand, Chemistry of Solids by Prof. A. R. Leeds, Ventilation by L. W. Leeds, and Mechanics by Morton.[15]

The smaller venue at the Franklin Institute precluded the use of the most elaborate special effects presented at the Academy of Music. Presumably some of the lecturers relied mostly on demonstrations with scientific apparatus, although the lectures by Pliny Chase on astronomy probably included magic lantern slides. Lewis W. Leeds also used magic lantern slides taken from lithographic prints to illustrate his lectures on home ventilation (Fig. 6).

Fig. 6. Lantern slide image used by Lewis Leeds in his lectures on ventilation. From Leeds (1868).

Morton used both demonstrations with various kinds of apparatus and magic lantern projections. In November 1866, he gave a lecture on "Electricity and Light." This lecture apparently did not include a magic lantern, but instead featured instruments for generating electricity, a type of entertainment going back to the days of Benjamin Franklin. Here the apparatus itself was considered part of the attraction:

> Before the entrance of the lecturer, the assembling audience found entertainment in observation of the beautiful apparatus, glittering with brass and glass, and rich with polished wood and velvet, with which the lecture table was covered, and a new drop curtain, painted by Russell Smith, which closed the view in that direction, and which very appropriately displayed, on tablets inserted between columns of porphery and panels of rich marble, paintings of Franklin's experiment with kites, and the *Great Eastern* laying the Atlantic Telegraph cable.[16]

Morton used a Ruhmkorff coil to perform a variety of electrical tricks that were standard fare for electrical demonstrators, including the "lightning mirror," in which a "spark is produced against the face of a looking glass, on which it breaks into a multitude of purple branches of fire."[17]

Morton's lecture at the Franklin Institute was so well attended that many people were left standing outside the door; one of these complained to the local newspaper:

> Would it not be well for the Managers of that admirable institution to have this lecture of such popularity repeated, or given in some place capable of accommodating more than two or three hundred, which we believe is the capacity of the audience chamber?
>
> From all we hear, the lecture was a most brilliant and instructive affair, and we regret that we had not the pleasure and profit of hearing it. Will not the Institute secure the Academy of Music for such purposes? Professor Morton's lectures there last winter and the winter previous were all attended by crowds; and multitudes are very anxious for a continuance of the same instructive and entertaining exhibitions.[18]

Morton began the 1867-68 lecture season at the Franklin Institute on November 12, 1867 with a lecture on "Light," in which the magic lantern and other apparatus came into play:

A large disc was caused to revolve in front of the audience, and had upon it an irregular figure. The disc was illuminated by frequent recurrent flashes of light, and by varying the interval between these flashes, the figure seemed completely changed, though it still remained the same, and its motion was retarded, reversed and accelerated.

The lecturer took up the (to us) novel subject of "sun spots," and made it quite plain by means of various pictures (photographs, we presume) of these same spots that they were nothing more nor less than a gigantic storm, sweeping tornado-like over the surface of the sun, and rending great rifts or tears in the brilliant vapor masses which were forever surrounding that orb (Fig.7) . . . .

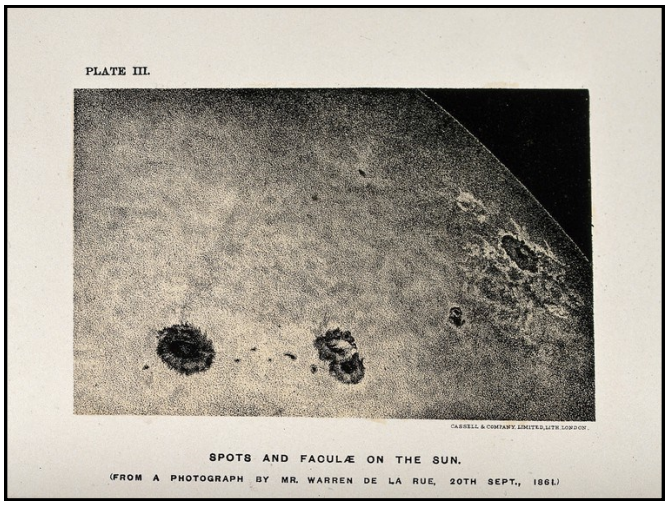


Fig. 7. Lithograph of sunspots from a photograph by Warren De La Rue in 1861. Wellcome Collection.

Explanations of the laws of reflection followed, and a graceful and singular illustration was given by the exhibitor of "The Veiled Image." A large mirror was placed in front of the audience and appeared wholly vacant. The moment, however, that a thin gauze veil was thrown over the mirror, a beautiful figure appeared, which vanished from the place as the veil fell and seemed to lie tangled in the meshes of the net in which it had been caught. . . . Pictures of the zodiacal light [Fig. 8] and graceful statues closed a most interesting lecture on *Light*.[19]

Morton returned to the larger venue of the Academy of Music on May 23, 1868 with a lecture on "Sunlight." He repeated some of the experiments performed at the Franklin Institute and added other spectacular effects.

Fig. 8. Lithograph of the zodiacal light. From: Sir Robert Ball, *The Story of the Heavens* (Cassell & Co., London, 1900)

After describing the physics of sunlight with diagrams projected on a screen by a magic lantern, Morton performed several experiments involving the burning of metals to simulate the sun's heat and the light produced by the heat:

He illustrated the sun's heat by means of a larger compound [oxyhydrogen] blowpipe. The lecturer being elevated by means of one of the stage-traps to a height of about ten feet, he burned a rope of steel wire, steel rods, magnesium wire, &c., and the shower of fire falling on the stage spattered and danced like raindrops, and rolled in a flood of light toward the footlights.

After this rather risky experiment, Morton performed others involving the Rhumkorff coil and a rotating wheel with electrically illuminated spokes to produce an ever-changing star of brilliant rays. He then illustrated the effects of different colors of light on the perception of the colors of objects:

The great experiment of the evening was the alternate illumination of brilliantly-colored scenes by white and a monochromatic light. Thus the painted drop curtain of the theater, lowered for the occasion, was now shown in all its brilliancy of color, then was changed instantly into a charcoal sketch or monochrome. The curtain then being raised, revealed a ball-room scene. A long line of masquers, all dressed to represent the various primary colors, with banners illustrating the same, came in under a flood of light from three calcium burners. Then the white light vanished, and in its place, ninety Bunsen burners, arranged in groups, threw over the gay picture a flood of yellow light. The effect

was marvelous. All traces of color vanished, and a ghastly hue took its place, to be likened only to the livid hue of death, filling likewise the entire house. This was to show that the color we see in all objects comes from the light used, and not from the object seen.[20]

This lecture was so popular that Morton agreed to repeat it on June 3, 1868, but he modified the title and contents to "Sunlight and Moonlight." The "veiled image" trick was repeated, supposedly to illustrate the difference between emitted light (as from the sun) and reflected light (as from the moon), although in a rather indirect manner. He further illustrated reflected light by projecting magic lantern slides of various images, such as a statue standing next to a mirror and "landscapes with still waters reflecting the adjacent objects." Next came some lantern slides of photographs, drawings, and diagrams of the moon:

After the illustrations of reflection above mentioned, came a series of moon photographs, intermixed with copies of lunar maps and a number of imaginary views of lunar scenery, from drawings prepared by Mr. James Hamilton, our eminent artist. . . . These views are of the most impressive description, especially one of the lunar volcano, Copernicus, and its vicinity, as seen by earth light [Fig. 9]. . . .

Fig. 9. View of the moon's Crater of Copernicus, with the Earth in the background, from a drawing by James Hamilton. From Sellers and Leeds (1892).

The direct lunar photographs, by Mr. Rutherford [Rutherfurd], were also most effective [Fig. 10]. Thus we beheld, to our great delight, a moon, round and full- orbed, as bright as the original luminary, but rolling on to the screen as a globe of 35 feet in diameter, her mountains and volcanic cones and extended plains distinctly visible.[21]

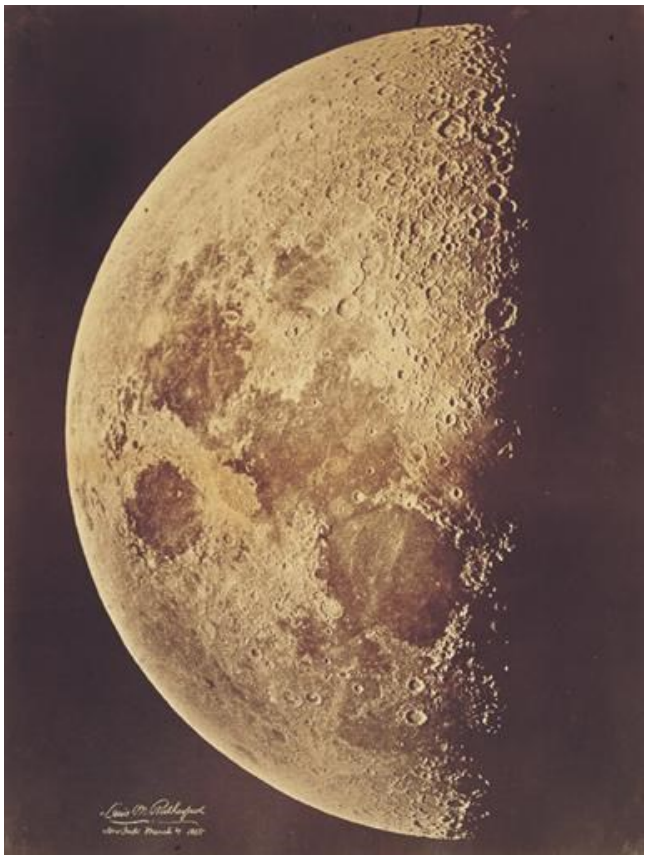


Fig. 10. Photograph of the Moon by Lewis M. Rutherfurd.

Wikimedia

To achieve the desired visual effects in such a large hall, Morton used an unusually large custom-made dissolving view lantern with extra-large slides:

The front of the stage is 50 feet in width, and the most distant part of the audience more than 100 feet from that point. An immense screen and powerful illumination are therefore necessary. The screen employed was of wet muslin, 40 feet square, lowered into its place at the moment when required. To cover and illuminate brilliantly such a surface (1,000 square feet), no ordinary lantern would suffice, and, accordingly, Professor Morton has had one constructed by Mr. Zentmayer, with condensers eight inches in diameter, and of 3-inch focus, with which pictures of corresponding size are used. Thus an objective of lower power may be employed and loss of light avoided, as also a large ignited surface of lime utilized without injury, on account of the corresponding increase of size in all parts.[22]

One of Morton's most spectacular lectures was given at the Philadelphia Academy of Music on June 1, 1869 on "Vision." He combined elements of previous lectures, such as the aquarium tank, with an enhanced phantasmagoria show, a simulation of a gigantic zoetrope, and other visual effects:

> He explained the structure of the human eye [Fig. 11], or organ of vision, in its twofold character of an optical instrument, collecting and arranging light rays like an ordinary glass lens, and of a sensitive nerve screen, receiving and appreciating in many various ways the rays falling upon it. To illustrate the inversion of an image caused by an ordinary lens, a little aquarium was placed behind a lens and illuminated by a powerful lime light so that a vast image of the aquarium was projected on the screen which covered the front of the stage for a space of forty feet square. There then appeared, as it were, a section of the ocean with whales, sea serpents and crocodiles from thirty to fifty feet in length, swimming about on their backs, while the surface of the water, clearly defined, was below, and a fresh quantity poured in was seen to streams upwards from beneath. The vast apparent magnitude of these creatures, and their strange motions, rendered the scene remarkable and amusing in the extreme, as was testified by the repeated applause of the audience, who insisted on having the aquarium returned to the lantern after it had been removed by the assistants. . . .

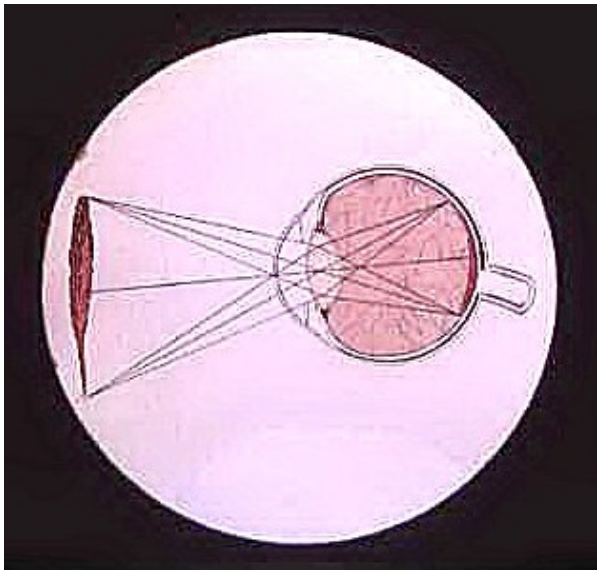


Fig. 11. Lantern slide of a diagram of the human eye.

Wells collection

> The sensitiveness of the eye to faint impressions of light was then discussed, and in connection with this subject was explained the method of Lockyer and Janssen, by which the solar clouds or flames heretofore seen during a total eclipse only could now be viewed at all times. This part of the subject was illustrated with drawings and photographs of total eclipses, taken in 1860 by De la Rue and last year by Dr. Vogel, projected on the screen [Fig. 12]. The lantern is now frequently used for such purposes; but we have never seen such pictures projected with such vast size and with such great brightness as were these used throughout this lecture.

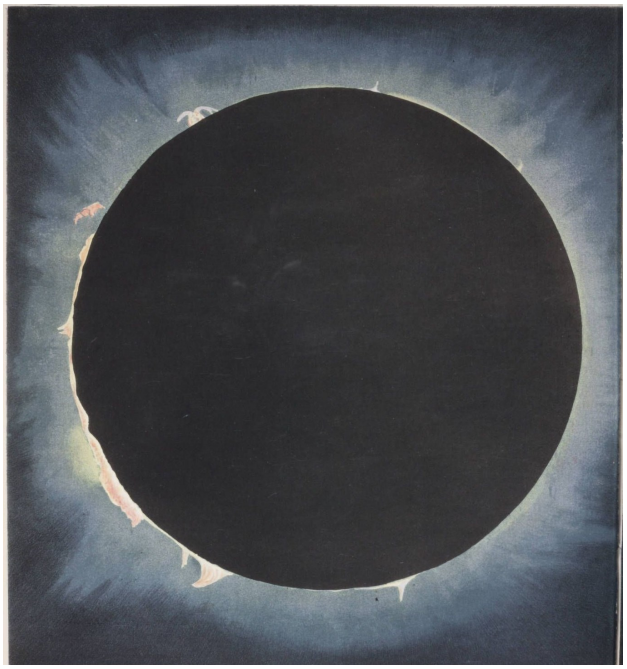


Fig. 12. Photograph of the total solar eclipse of 1860 taken by Warren De La Rue in Spain.

Linda Hall Library Digital Collections

> The method by which the eye judges as to the distance of objects was then explained, and the very limited range of its capacity in this respect was illustrated by the phantasmagoria, in which images always in the same place are made to approach and recede by a mere change in magnitude. This arrangement has been exhibited before, but never, we imagine, on so grand a scale or with such remarkable success. The entire space of the stage seemed to be occupied by a vast tunnel, from the far depths of which a locomotive advanced with

steady rush, towering up to gigantic size, until, when some twenty-five feet high and about to plunge into the orchestra, a whistle sounded and tunnel, locomotive and all melted away into an ocean grotto of the sea nymphs. From the depths of a vast cavern advanced a grisly skeleton, who, just when he seemed ready to crush the adjacent spectators by his next footfall, waved his arms, nodded and, turning round, sped back into his dreary tomb. Angels flying forward from a cluster of stars, statues advancing and retreating through vast vistas of colonnades and galleries, and vast colored balls that rolled and unrolled their intricate convolutions further illustrated the same points. . . .

The subject of persistence of vision was then illustrated, first, by large discs six feet in diameter, with devices of balls, rings, &c. painted upon them, and rotated, while they were illuminated by rapidly recurring flashes of light. All the effect of the best zoetrope was thus displayed to the immense audience with far greater clearness than in the ordinary instrument, for there was no seeming interruption in the view. The great discs stood directly before the house, and were directly viewed with no intervening object. . . .[23]

Morton and the Solar Eclipse of 1869

Following this June lecture that included photographs of two solar eclipses from the 1860s, Morton spent much of the summer organizing an expedition to Ottumwa, Iowa, to observe and photograph a total solar eclipse that was to occur on August 7, 1869. The group included a number of scientists and photographers, including Philadelphia photographer Edward L. Wilson. This was just one of several private and government expeditions sent to various sites from Alaska to Kentucky to observe and photograph the eclipse. Morton's expedition produced some high quality photographs of the eclipse, some of which appeared as plates in Wilson's *Philadelphia Photographer* (Fig 13 and front cover).[24]

Following Morton's Iowa eclipse expedition, he gave periodic lectures on "Solar Eclipses," although as with most of his lectures, these included various special effects only tangentially related to eclipses. One such lecture was given at the Academy of Music on February 28, 1870. This was part of a "Star Course" of lectures organized by Philadelphian T. B. Pugh, one of a new breed of lecture tour managers that proliferated in the 1870s. Morton was the first lecturer for the season, followed by the famous traveler Bayard Taylor, the poet John G. Saxe, chemist Robert G. Rogers, and crusading orator Anna E. Dickinson.[25]

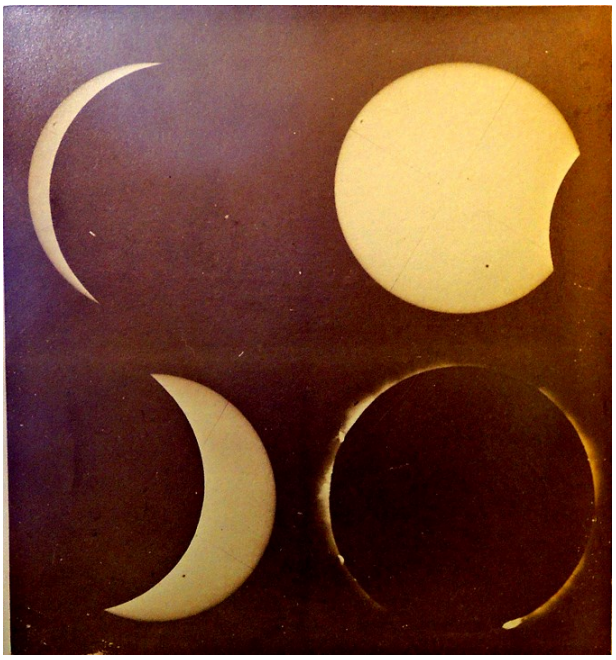


Fig. 13. Photographs of different phases of the solar eclipse of 1869, taken by Henry Morton's photographic expedition to Ottumwa, Iowa.

Princeton University Library

Morton first explained how a solar eclipse occurs using an orrery (a mechanical model of the solar system), with the sun represented by a globe containing a zirconia burner. This was followed by two experiments on shadows. In the first, a person holding a globe like Atlas moved through colored beams of light projected on the screen, casting shadows of various colors. In the second, "Legions of Angels" were produced by assistants behind a translucent screen burning strips of magnesium, producing droplets of fire that shined light through a large cardboard cutout of an angel. Light coming from different angles produced multiple angel images that moved upward as the burning magnesium fell downward toward the stage.[26]

Next Morton produced an artificial eclipse using a specially designed lantern slide based on photographs of the 1869 eclipse (Fig. 14), followed by projected photographs of the 1869 eclipse and the earlier ones:

Passing next to the actual appearance of an eclipse, an illustration was shown whereby all the characteristic actions and changes of a total eclipse of the sun were artificially reproduced. The bright solar disk was first seen with the sun spots upon it as observed

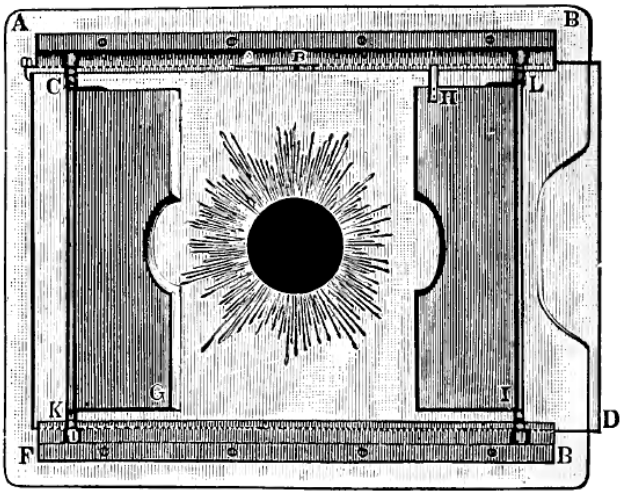


Fig. 14. Henry Morton's solar eclipse lantern slide. Initially the wooden shutters would be closed, showing only the bright sun disc. A dark disc gradually moves over the sun until it is completely covered, at which point the shutters snap open, revealing the sun's corona. The slide was based on photographs taken of the 1869 eclipse, such as the one on the front cover. From Sellers and Leeds (1892).

> and recorded photographically during the eclipse of last August. Then the moon, with its rugged edge, as shown also in the photographs, crept slowly over, cutting down the solar disk to a crescent of ever narrower dimensions; then came the broken line of light known as Bailly's beads; and lastly, at the instant of totality, or when the last direct sun was cut off, came with the suddenness which all observers have noticed, the glories of the corona and prominences. . . .
>
> Photographs obtained at the late eclipse and on previous occasions, were then shown and explained, and the character of the solar prominenses and the corona discussed, the former being illustrated by some experiments with colored liquids, and the latter by a splendid display of electric discharges in exhausted tubes.[27]

Morton's lecture on eclipses was so successful that he agreed to repeat it two weeks later, on March 14, 1870, with some new demonstrations and experiments. Among other additions was the burning of a sword with an oxyhydrogen blowpipe to illustrate the heat of the sun, a demonstration recycled from his earlier lecture on sunlight and having little to do with eclipses.[28]

Prof. Morton Takes His Shows on the Road

A few months after Morton's second lecture on eclipses, in June 1870, he resigned his position as Secretary of the Franklin Institute to take up a position as President of the newly formed Stevens Institute of Technology in Hoboken, New Jersey. His new position required a lot of attention to administrative and scientific matters, but did not immediately interrupt his career as a popular science lecturer. In fact, he had already begun to take his lectures to cities within an easy train ride from Philadelphia, and later, Hoboken, including Baltimore, New York, Providence, and Washington. Once relocated to New Jersey, he also returned periodically to lecture in Philadelphia. Many of these road trips, from 1869 through 1874, were sponsored by T. B. Pugh's Star Course tour, where he shared billings with well known orators, travelers, scientists, and literary figures. Some of his lectures were new, but others recycled all or parts of previous lectures.

Baltimore—In November and December 1869, Morton delivered a series of four lectures on "Light" at Baltimore's Peabody Institute. One lecture on "Color" included familiar experiments such as blending colored beams of light into a single beam of white light, and splitting a beam of white light from a limelight lantern into all of colors of the spectrum using a prism. He also demonstrated the disappearance of colors of objects in the theater when white limelight was replaced by pure yellow light, along with other familiar experiments. Another lecture in the 1869 series focused on polarized light.[29] Morton returned to Baltimore in November 1870 for a series of six lectures on "Light." One lecture included elements of previous lectures, including lantern slide diagrams illustrating the structure and function of the human eye in comparison to ordinary lenses and the deconstruction of a white beam of light on the screen into three colored beams. The final lecture in this series was to include the topic of polarized light discussed the previous year, as well as the new topic of the gas [oxyhydrogen] microscope.[30]

At some point, Morton also delivered a lecture in Baltimore entitled "The Magic Lantern," although the precise date is uncertain. In this lecture, he used his custom-designed vertical lantern (see below) to demonstrate several kinds of projection, beginning with an oxyhydrogen microscope with which he projected immensely enlarged insects. After projecting the eye of a fly, he showed a lady bug ["a horrid beast, which is applauded by the men and audibly deprecated by the ladies"]. There also was a succession of "living animalculae" in a small amount of

water in a hollow ground into a microscope slide. Using a larger water tank, he then displayed a large water insect ["a black, misshapen, awful bug appears; these bugs appear the size of crocodiles, of course."] Morton then reconfigured the lantern to project images of solid objects, the first of which was an enormous live image of his own hand. He asked his assistant, Mr. Varley, to step forward to show the scale of the image: "Mr. V. approaches; he is about the size of the little finger; the monster makes a clutch at him, and Mr. V. recoils in simulation of terror" (Fig. 15). Other solid objects were shown: a gigantic apple; a wine glass, which appeared inverted, into which he poured wine *upward*; a medallion; a brace of young people spooning; a mother of pearl shell showing its peculiar iridescence; and other shells. Finally the inner workings of the professor's own pocket watch were enormously enlarged on the screen.[31]

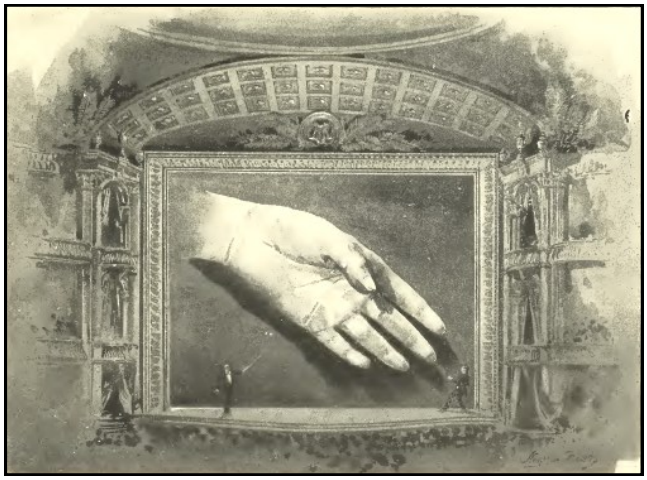


Fig. 15. Enlarged living hand projected on the screen. Morton's assistant recoils in fear at the right side of the stage. From Sellers and Leeds (1892).

New York—Morton lectured several times in New York in 1871 and 1872. During the 1870-1871 lecture season before the American Institute (meeting at the New York Academy of Music), Morton delivered the final lecture, on "Light," in February 1871. This lecture combined familiar elements from previous lectures, including the structure of the eye, light and color effects, refraction and reflection, and phantasmagoria effects such as a locomotive approaching the audience in a tunnel and the appearance of looming statues, skulls, and rolling balls on the screen.[32] Morton returned to the same venue in the fall, delivering the first lecture in the series, on "The Nature and Sources of Light," on November 23, 1871. His familiar experiments on ways of producing light were presented, along with the burning sword, the artificial rainbow, and various magic lantern tricks.[33] He was back in New York in March 1872, when he lectured on "Flourescence," a subject of his own personal research at Stevens Institute. He was in New York again in the fall, this time as part of a Y.M.C.A. lecture series that included such notable speakers as John B. Gough, Harriet Beecher Stowe, and James T. Fields. His topic was "Flourescent Light," presumably much the same as his spring lecture.[34]

Providence and Washington—Morton visited Providence, Rhode Island in January 1873 and lectured in Music Hall on "The Eye: Mysteries of Vision and Light," sponsored by the Providence Franklin Society and the Mechanics' Association. Presumably it covered topics familiar from previous lectures. This was the first of a series of scientific lectures sponsored by these organizations, all of which were to be "illustrated by brilliant experiments with extensive philosophical and chemical apparatus, and by paintings, drawings and diagrams of great interest." Other speakers in January and February were Prof. E. S. Morse of Bowdoin College on "How Animals Move," Prof. H. W. [W. H.] Niles on "Scenes Among the Upper Alps," Prof. Young of Dartmouth College on "Structure and Motions of the Heavenly Bodies" (illustrated by the magic lantern), and B. Waterhouse Hawkins on "The Age of Dragons in Europe and America."[35]

The Providence newspaper reported that Morton was already "immensely popular" in New York, Philadelphia, and Washington, and he visited Washington again in 1874 as part of a Y.M.C.A. lecture series, sharing the stage with familiar figures such as Bayard Taylor, James T. Fields, and Prof. E. S. Morse.[36]

Philadelphia—During his road trips, Morton returned to his home town of Philadelphia several times between 1871 and 1874. In June 1871, Morton returned to the Academy of Music to deliver his now familiar lecture on "Light." As in Baltimore, he used a vertical lantern of his own design, which he used to project waves made by a tuning fork and other experiments, as well as photographs of sunspots and a solar eclipse. He also included familiar features such as burning a sword with an oxyhydrogen blowpipe and demonstrations of limelight and other methods of light production.[37]

He appeared at the Academy of Music the following fall to deliver a lecture sponsored by the Franklin Institute on "Reflection." Again using his vertical lantern, Morton projected sound waves produced by

applying a violin bow to the edge of a glass plate covered with a thin layer of water. The experiment with a mirror to produce a "veiled image," now renamed "The Phantom of the Mirror," was then shown:

> But on its surface, also, the professor said, was one of the spirits of sight which are slaves to the philosopher and his "magic lantern." This phantom was, however, too timid to show herself unless veiled, and the professor therefore proceeded to let fall on the surface of the glass a white lace veil, when instantly a luminous fairy like figure was seen apparently within. After a few minutes the veil was gathered together and allowed to fall, the figure shrinking together in its folds and falling with it to the ground.

Morton then used his vertical lantern to project images produced by drops of essential oils falling on a shallow pan of water. The high point of the lecture was the use the lantern to project solid objects, many of them the same as those shown in Baltimore:

> The megascope followed next in order, and with its wonderful production of Brobdignagian monsters, in the shape of a living moving hand some twenty feet long, an apple ten feet high, the moving works of a watch whose balance wheels would have made a good fly wheel for a twenty horse power engine, and the like, produced no little amusement and surprise.[38]

Morton returned to Philadelphia's Academy of Music in November 1872, as a speaker in Pugh's Star Course series. He spoke on "Flourescence," a lecture given in New York the previous month on his own personal research interest. He returned again in March 1874 as the seventh speaker in that season's Star Course series, lecturing on "Color," which repeated many of the experiments used in previous talks on the subject.[39]

Prof. Morton's Vertical Lantern

One of Henry Morton's goals in developing the Stevens Institute into the premier technical and engineering school in the country was to ensure that it was equipped with the most up-to-date scientific instruments, including the latest in projection technology. To this end, a corner of the building's third floor was assigned as a workshop for the commercial instrument making firm of Hawkins and Wale, which became the official instrument maker for the Institute, while also selling their products to the public. Both Henry Hawkins and George Wale were known for their optical instruments, especially microscopes, and Wale constructed custom magic lanterns and accessories for Henry Morton. His best known product was the Vertical Lantern (Fig. 16), which Morton began using for his lectures in 1871. This new style of lantern provided a horizontal glass platform which could be used for physical and chemical experments. Limelight from the lantern was reflected onto the platform by a diagonal mirror inside a box attached to the front of the lantern. The light passed through the platform to a set of lenses, which focused the light on another diagonal mirror, which in turn projected the image onto the screen. The refined commercial version of this lantern, known as the College Lantern, was widely adopted for use in colleges and universities. By removing the mirrors and adding accessory lenses, the lantern could be adapted for projection of regular lantern slides (Fig. 17), projection of microscope slides, and even projection of images of solid objects like the giant human hand and moving watch parts shown in Morton's lectures.[40]

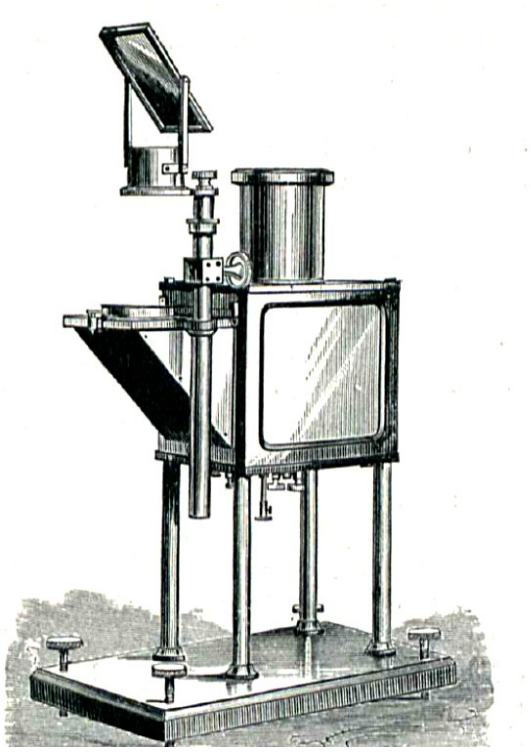


Fig. 16. Henry Morton's College Lantern, the refined commercial version of his Vertical Lantern, made by George Wale.

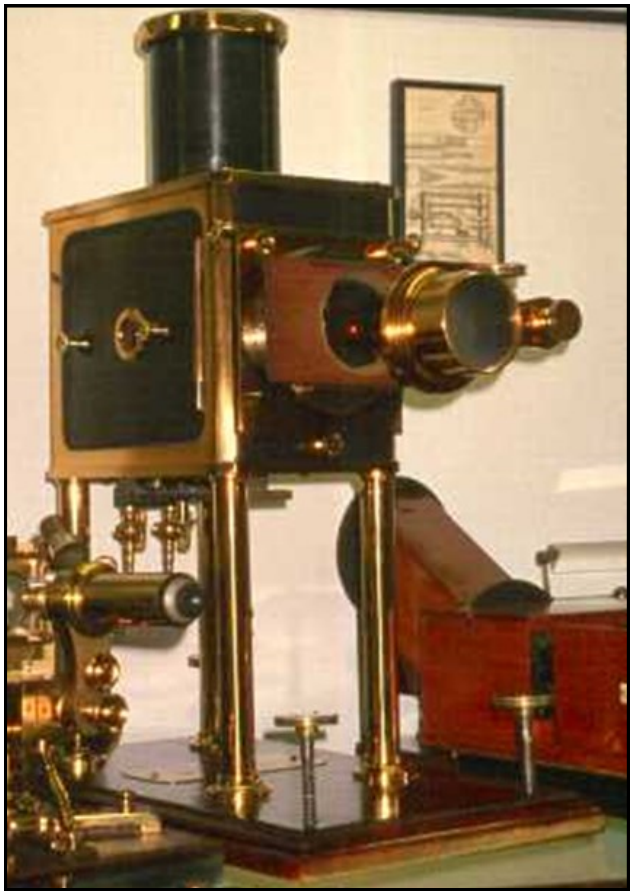


Fig. 17. Morton's College Lantern, configured for projection of lantern slides. Jack Judson collection.

Morton actively promoted the vertical lantern through public demonstrations and articles published in a number of scientific periodicals. For example, he gave a demonstration to the Polytechnic Branch of the American Institute, meeting at the Cooper Institute in New York, on February 23, 1871. Written descriptions, all with similar wording, appeared in *The American Journal of Science and Arts* in July 1871, in *Chemical News* in August 1871, and later in *Scientific American* in September 1873. Although Morton prepared the design of the lantern for George Wale to follow in constructing it, he was careful to credit the original idea for a vertical lantern to his friend and colleague, Prof. Josiah P. Cooke of Harvard, who showed him his own model in the summer of 1870.[41]

Josiah Parsons Cooke (1827-1894) (Fig. 18) was a chemist and prolific lecturer who designed his own magic lanterns. In 1850, only two years after graduating from Harvard, and with little training in chemistry, he was named the Erving Professor of Chemistry and Mineralogy at Harvard, a position he held for the rest of his life. Harvard was desperate to hire a chemistry instructor, his predecessor having been hanged for the murder of a fellow faculty member. Cooke was the first chemistry instructor in the country to incorporate laboratory work into his teaching. Eventually he became one of the leading experimental chemists in the United States and was elected to the National Academy of Sciences.[42]

Fig. 18. Prof. Josiah Parsons Cooke c. 1865.

Wikimedia

Cooke began designing and using magic lanterns in his lectures in the 1850s. In addition to using lanterns in his teaching, Cooke was the fourth most frequent contributor to the prestigious public lecture courses sponsored by the Lowell Institute (Harvard naturalist Louis Agassiz being the most frequent lecturer). The Lowell Lectures usually were given as courses of 6-12 lectures by each individual. Cooke gave his first course of 12 lectures on "Chemistry of the Non-metallic Elements" during the 1855-1856 season. He employed a vertical lantern of his own design for these lectures; this was the lantern shown to Henry Morton in 1870. Cooke did not publish a description and drawing of his vertical lantern (Fig. 19) until December 1871, after

Morton had introduced his own version of the lantern. Probably the light source for Cooke's vertical lantern was a basic electric carbon arc lantern illustrated in an 1865 article, "On Projection of the Spectra of the Metals" (Fig. 20).[43]

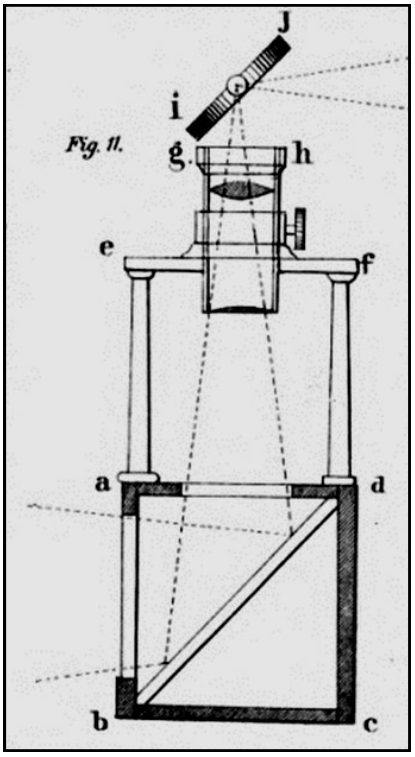


Fig. 19. Vertical lantern designed by Josiah P. Cooke in the 1850s, which served as a model for Morton's own version of the vertical lantern. The light source was an electric carbon arc lantern aligned with the vertical lantern at left. From Cooke (1871).

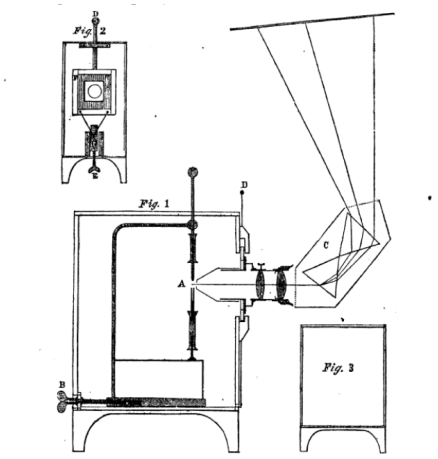


Fig. 20. Electric carbon arc lantern designed by Josiah P. Cooke, configured for projecting the color spectra of metals. From Cooke (1865).

Cooke went on to lecture on a variety of topics in the Lowell Institute courses, presumably using his lantern for many of these. Among the topics he covered were "Chemistry of the Atmosphere as Illustrating the Wisdom, Power and Goodness of God" (1860-1861), "The Sunbeam, its Nature and Power" (1864-1865), "Electricity" (1868-1869), "Crystals and Their Optical Relations" (1878-1879), and "Photographic Sketches of Egypt" (1892-1893). In February 1865, Louis Agassiz began his 12-lecture Lowell Institue course on "The Glaciers and the Ice Period." The initial lecture in the series was illustrated by photographic slides of the Swiss Alps, projected by Cooke with his "stereopticon," which in fact was the same vertical lantern used in his own lectures ten years earlier. Agassiz was not known for using projected images in his lectures, preferring diagrams, maps, and his own blackboard drawings.[44] The slides shown in his initial lecture may have belonged to Cooke, a product of earlier travels in Europe. Cooke later gave his own lecture on "Mont Blanc and the Glaciers of Switzerland," with "stereoscopic illustrations and electric lights" before the Mechanics Association in Providence, Rhode Island.[45]

Prof. Morton's Later Career

When Morton became the first President of Stevens Institute of Technology, he focused on hiring faculty members and developing the Institute into the premier mechanical engineering school in the country. He did not, however, completely abandon public lecturing with the magic lantern. In fact, he developed a public lecture program at Stevens Institute modelled on the one sponsored by the Franklin Institute, with Morton and other professors contributing to the series. Many of his lectures touched on familiar topics. In 1873, for example, he gave the inaugural lecture for the Spring course on "Moonlight and its Source," which included "enlarged lunar representations being thrown upon a canvas from a lens."[46] In 1875, he again gave the first lecture in the series, this time his well known lecture on "Color" (He was still lecturing on "Color" as late as 1892, when he appeared at the Young Men's Institute Hall in New York).[47]

In 1876, Morton lectured at the Stevens Institute on "The Optics of Photography." Much of the lecture was illustrated with hand-drawn diagrams projected with his vertical lantern to explain the design of lenses. He also showed that even a concave watch glass filled with water could function as a lens: "The lecturer placed a watch glass in the path of the rays coming from a vertical lantern containing a slide of a fine piece of statuary. Nothing was visible on the

screen until he poured water into the watch glass, when the image came out with surprising distinctness." He then went on to demonstrate the megascope, with familiar images of a living hand, gigantic apple, moving watch works, and other effects.[48]

Morton had a long-standing interest in artifical lighting, not only for the magic lantern, but also for household, industrial, and outdoor use. He was a member of the Lighthouse Board and made numerous measurements of the intensity, color, and efficiency of various light sources. When Thomas Edison, working in his laboratory in Menlo Park, New Jersey, made his first successful demonstration of an incandescent light bulb in 1879, Morton was not impressed. He complained that compared to an electric carbon arc lamp, the light produced by Edison's light bulb was very dim and yellow rather than bright white, not at all like sunlight. He also pointed out that carbon filaments used in some of Edison's early bulbs did not last more than a few hours or at best, a few days. Using a sample bulb provided by Edison to *Scientific American*, Morton compared the light output of Edison's bulb with common household gas lamps, as well as the amount of energy input needed to produce the light. Both in intensity and efficiency, he found Edison's bulb lacking and predicted that electric lighting would not replace gas lighting for interior illumination in the near future.

Morton published articles on the electric light in various scientific journals, some of which were summarized in newspapers. He also gave a series of three illustrated public lectures at 10 year intervals (1878, 1889, 1899) before the American Gas Light Association on recent progress in the development of the electric light. In each case, he expressed skepticism about the practical uses of the incandescent light bulb compared to illuminating gas. Edison was not amused by Morton's criticism, and relations between the two men soured, with Morton becoming one of Edison's most persistent critics. Nevertheless, Morton published an article in *Scribner's Magazine* in 1889 giving a comprehensive illustrated history of electric lighting, including Edison's role in the development and manufacture of incandescent light bulbs.[49]

Morton maintained cordial relations with many other scientists and lecturers, often assisting other lecturers with loans of equipment or helping to project images. He was particularly attentive to foreign visitors. When John Henry Pepper and John Tyndall embarked on their American lecture tours in the 1870s, both men visited Morton in Hoboken. Morton had been influenced by the lecture techniques of Pepper and Tyndall, as described in their published writings, and borrowed some of their experiments. Morton also assisted Tyndall with some of his experiments, and Tyndall was especially impressed by Morton's vertical lantern.[50] Morton also assisted visiting British astronomer and popular lecturer Richard Proctor with his lectures. When he spoke in New York in January 1874, Proctor illustrated his talks with "the powerful Oxyhydrogen Stereopticon of the Stevens Technological Institute."[51] Taken together, Morton's spectacular lectures, his tireless advocacy for the use of the magic lantern in scientific demonstrations, and his assistance to other magic lanternists, truly made him "the prince of American lecturers on science."

Notes and References

1. "Prospectus," *The Magic Lantern* (Philadelphia), vol. 1, no. 1 (September 1874), p. 1. Morton published a variety of short articles in *The Magic Lantern*, including a series on "Magic Lantern Practice," which borrowed heavily from his previously published articles in the *Journal of the Franklin Institute*, *Scientific American*, *American Journal of Science and Arts*, and other scientific periodicals.

2. Until recently, Morton's work with the magic lantern has received little attention from modern scholars. However, Michele Pierson has written about his use of special effects in his lectures, comparing him to John Henry Pepper of the Royal Polytechnic in London. Jeremy Brooker also has discussed his magic lantern work in relation to lectures given by Pepper and John Tyndall on their tours of the United States. See: Michele Pierson. 2002. *Special Effects: Still in Search of Wonder* (Columbia University Press, New York) (Chapter 1: Magic, Science, Art: Before Cinema); Jeremy Brooker. 2017. A lecture on Locust Street: Morton, Tyndall, Pepper, and the construction of scientific reputation, pp. 111-138. In: Carin Berkowitz and Bernard Lightman, eds. *Science Museums in Transition: Cultures of Display in Nineteenth-Century Britain and America* (University of Pittsburgh Press, Pittsburgh PA). Morton published a multi-part article on 'The magic lantern as a means of demonstration" in the *Journal of the Franklin Institute*, which described details of lantern construction and management, as well as technical details of experiments described in newspaper accounts of his lectures: Henry Morton. 1867. The magic lantern as a means of demonstration [part 1]. *Journal of the Franklin Institute*, January 1, 1867:55-58; [part 2] March 1,, 1867:204-206; [part 3] April 1, 1867:282-284; [part 4] May 1,, 1867:354-356; [part 5]: June 1, 1867:409-412; [part 6]: August 1, 1867:130-134; [part 7] September 1, 1867:206-209; [part 8] October 1, 1867:278-281; [part 9] November 1, 1867:339-342; [part 10] January 1, 1868:62-66; [part 11] April 1, 1868:277-278; [part 12] May 1, 1868:345-347; [part 13] June 1, 1868:420-422; [part 14] September 1, 1871:208-211. The 1871 part described new developments on topics discussed in the previous parts.

3. Several memoirs and biographical sketches of Henry Morton were published during his lifetime and after he died. The contents of these sketches are very similar, as they borrowed and quoted from each other. The main biographical source is: Coleman Sellers and Albert R. Leeds. 1892. *Biographical Notice of Pres't Henry Morton, Ph.D. of the Stevens Institute of Technology* (Stevens Institute of Technology, Hoboken NJ). This was summarized in: "Biographical notice of President Henry Morton,

Ph.D. of the Stevens Institute of Technology (Stevens Institute of Technology, Hoboken NJ). This was summarized in: "Biographical notice of President Henry Morton, Ph.D. of the Stevens Institute of Technology," *Wilson's Photographic Magazine*, August 6, 1892. See also: Prof. Coleman Sellers. 1903. Henry Morton. *Cassier's Magazine* 24:337-344. Edward L. Nichols. 1915. *Biographical Memoir of Henry Morton 1836-1902* (National Academy of Sciences, Washington DC), pp. 143-151.

4. Nichols 1915, p. 144 (see note 3); Sellers and Leeds 1892, p. 17 (see note 3). Morton's evening lectures at the Episcopal Academy were open to the public, as shown by a newspaper anouncement of a chemistry lecture: "Mr. Morton's Lecture," *North American*, April 3, 1862, p. 2. The original Academy building on Locust Street no longer exists; the site is occupied by the Library Company of Philadelphia. The Episcopal Academy now has a large campus in Newtown Square PA.

5. "In-door Rainbows," *The Press* (Philadelphia), April 26, 1865; reprinted in Sellers and Leeds 1892, pp. 26-29 (see note 3).

6. Sellers and Leeds 1892, p. 29.

7. Sellers and Leeds 1892, p. 18.

8. "Prof. Morton's Lecture on Light," *Philadelphia Inquirer*, May 10, 1865, p. 2. Morton repeated his rainbow effect in December 1865, when "Bona Fide Prisoners" released from the notorious Confederate prison at Andersonville, Georgia, appeared at the Academy of Music to present a series of *tableaux vivants* depicting their grim lives at Andersonville. Scenes included The Stockade, The Dead Line, The Dying Bugler, Issuing Rations, The Chain Gang, The Stocks, the Whipping Post, The Dead and Dying, and many others. Morton presented the "Prisoner's Rainbow of Hope" and "other striking effects of light and shade." The Collis Zouave Band from Germantown, Pennsylvania (114th Pennsylvania Volunteers) provided music (*Daily Evening Bulletin*, December 15, 1865, p. 2).

9. *Philadelphia Inquirer*, November 30, 1865, p. 1.

10. *Daily Evening Bulletin*, February 17, 1866, p. 1.

11. Ibid.

12. *Philadelphia Inquirer*, February 17, 1866, p. 1.

13. *Daily Evening Bulletin*, October 28, 1865, p. 6.

14. *Daily Evening Bulletin*, November 5, 1866, p. 6.

15. *Daily Evening Bulletin*, November 11, 1867, p. 1. Albert Ripley Leeds (1843-1902) simultaneously held positions as Professor of Chemistry at the Franklin Institute, the Philadelphia Dental College, and Haverford College. Later he was asked by President Henry Morton to organize the Chemistry Department at the Stevens Institute of Technology, where he remained for 30 years (see: *Proceedings of the American Chemical Society for the Year 1902*, pp. 53-57). Robert Empie Rogers (1813-1884) was a member of a whole family of distinguished naturalists and scientists. He was trained in chemistry by Robert Hare, inventor of the oxy-hydrogen blowpipe that led to the discovery of limelight. In the 1860s, Rogers was Professor of Chemistry at the University of Pennsylvania (*Wikipedia*). Pliny Earle Chase (1820-1886) was a Philadelphia scientist and educator who contributed to astronomy, electromagnetism, and other fields. In 1871, he joined the faculty of Haverford College as Professor of philosophy and logic (*Wikipedia*). Theodore D. Rand (1836-1903) was a Philadelphia lawyer and close associate of Henry Morton with interests in botany, chemistry, mineralogy, and geology. He was a member of the Academy of Natural Sciences in Philadelphia and served as Vice President of the Franklin Institute from 1897 until his death. See: https://mineralogicalrecord.com/labels.asp?colid=281. Lewis W. Leeds (1829-1896) was a Philadelphia engineer who became interested in the design of ventilation systems for hospitals and other buildings during the Civil War and became an expert on the subject. His Franklin Institute lectures on ventilation used a magic lantern to illustrate the movements of air currents in rooms. The lectures were published in 1868 with the illustrations used in the lectures. See: Lewis W. Leeds. 1868. *Lectures on Ventilation: Being a Course Delivered in the Franklin Institute of Philadelphia, During the Winter of 1866-67* (John Wiley & Son, New York). http://www.hevac-heritage.org/built_environment/pioneers/27-Leeds-Lennox.pdf.

16. *Philadelphia Inquirer*, November 7, 1866, p. 8. For American fascination with demonstrations of electricity inspired by Franklin's discoveries, see: James Delbourgo. 2006. *A Most Amazing Scene of Wonders: Electricity and Enlightenment in Early America* (Harvard University Press, Cambridge MA). William Thompson Russell Smith (1812-1896) was a Philadelphia artist who began his career as a theatrical scene painter and later became a well known landscape painter. In 1858, he received a commission to paint scenery for the Philadelphia Academy of Music ("William Thompson Russell Smith," *Wikipedia*). The Transatlantic Telegraph Cable carried electric telegraph signals between Newfoundland and Ireland, the final connection occurring in 1866, with the cable being laid by the steamship *Great Eastern* ("Transatlantic Telegraph Cable," *Wikipedia*).

17. *Philadelphia Inquirer*, November 7, 1866, p. 8.

18. *Daily Evening Bulletin*, November 7, 1866.

19. *Daily Evening Bulletin*, November 13, 1867, p. 5.

20. *Philadelphia Inquirer*, May 25, 1868, p. 8.

21. *The Philadelphia Photographer*, vol. 5 (1868), p. 231 (quoted in Sellers and Leeds 1892 [see note 3], p. 51). James Hamilton (1819-1878) was a Philadelphia artist known for his landscapes and seascapes. He also did drawings for illustrated books and magazines (http://www.askart.com/artist_bio/James_Hamilton/8807/James_Hamilton.aspx#). Lewis Morris Rutherfurd (1816-1892) was an American astronomer and inventor of the first telescope specifically designed for astrophotography. He produced many high quality photographs of the sun, moon, and planets (*Wikipedia*).

22. *The Philadelphia Photographer*, vol. 5 (1868), p. 50. Joseph Zentmayer (1826-1888) was a Philadelphia manufacturer of optical instruments, especially known for his microscopes. In 1869, he accompanied Henry Morton on the "Philadelphia Photographic Expedition" to observe and photograph a total eclipse of the sun in Iowa. He produced the photographic lenses and shutters for the expedition's telescopes. See: http://www.americanartifacts.com/smma/micro/zentsm37.htm. The condenser for the large Zentmayer lantern used by Morton is illustrated and described in: Henry Morton. 1867. The magic lantern as a means of demonstration [part 6]. *Journal of the Franklin Institute*, September 1, 1867:206-209. The lantern itself is shown in the August 1, 1867 issue (p. 132).

23. *New York Herald*, June 2, 1869, p. 3. British astronomer Norman Lockyer (1836-1920) and French astronomer Pierre Jules César Janssen (1824-1907) both developed a method of observing the sun's corona under daylight conditions, features previously visible only during total solar eclipses. See: W. W.

Campbell. 1920. Sir Joseph Norman Lockyer, 1836-1920. *Publications of the Astronomical Society of the Pacific* 32:265-266. Morton projected lantern slides made from photographs of a total solar eclipse in Spain in 1860, taken by Warren De la Rue (1815-1889), who was part of the first expedition specifically organized to photograph a solar eclipse. See: P. D. Hingley. 2001. The first photographic eclipse? *Astronomy and Geophysics* 42:1.18-1.23. He also showed slides taken from photographs of the solar eclipse of 1868 by Hermann Wilhelm Vogel (1834-1898). See: "Solar eclipse of August 18, 1868" (*Wikipedia*). See also: http://historiccamera.com/cgi-bin/librarium2/pm.cgi?action=app_display&app=datasheet&app_id=2372&.

24. https://graphicarts.princeton.edu/2016/05/24/1869-eclipse-photographed/

25. *Philadelphia Inquirer*, February 25, 1870, p. 5; March 7, 1870, p. 3. Peter Cherches. 2017. *Star Course: Nineteenth-Century Lecture Tours and the Consolidation of Modern Celebrity* (Sense Publishers, Boston).

26. Sellers and Leeds (1892) (see note 2), pp. 45-46 (quoted from the *Philadelphia Evening Bulletin*, March 1, 1870).

27. Sellers and Leeds (1892), pp. 46-48.

28. *Philadelphia Inquirer*, March 15, 1870, p. 2.

29. *Baltimore Sun*, December 1, 1869, p. 1.

30. *Baltimore Sun*, November 24, 1870, p. 4. Baltimore's Peabody Institute, founded in 1866 by philanthropist George Peabody, became a center of intellectual life in the city, with a school of music, concerts, and lectures. It is now part of Johns Hopkins University (*Wikipedia*). For the history of the gas, or oxyhydrogen, microscope, see: Kentwood D. Wells. 2017. Fleas the size of elephants: the wonders of the oxyhydrogen microscope. *The Magic Lantern Gazette* 29 (2/3) (Summer/Fall 2017):3-34. Morton later published a short article on the oxyhydrogen microscope, describing a custom-made attachment for an ordinary magic lantern to adapt it to microscopic projection: Henry Morton. 1876. The gas microscope. *Scientific American* 35:328.

31. "Professor Morton's Lantern Lectures," *The Magic Lantern*. August 1, 1875. 99-101. This article gives a transcript of Morton's Baltimore lecture on "The Magic Lantern" from another printed source, complete with audience reactions, but the date of the original is not given.

32. *New York Tribune*, February 6, 1871, p. 2.

33. *New York Tribune*, November 24, 1871, p. 5; *New York Herald*, November 24, 1871, p. 3.

34. *New York Times*, March 30, 1872, p. 3; *New York Herald*, October 28, 1872, p. 9. For Morton's research on flourescence, see Nichols 1915 (see note 3).

35. *Providence Evening Press*, January 11, 20, 22, 1873. Edward S. Morse (1838-1925) was an American zoologist who studied under Louis Agassiz at Harvard. In 1863, he and three other former Agassiz students founded the journal *American Naturalist*. From 1871 to 1874, he taught comparative anatomy and zoology at Bowdoin College, before moving to Harvard. He was elected to the National Academy of Sciences in 1876 (*Wikipedia*). William H. Niles was an American geologist and geographer who spent most of his career as a professor at the Massachusetts Institute of Technology. In the 1870s, he gave as many as 100 public lectures per year on physical geography and glaciation. See: Robert Rakes Shrock. 1982. Geology at MIT 1865-1965: *A History of the First Hundred Years of Geology at Massachusetts Institute of Technology: Department Operations and Projects* (MIT Press, Cambridge MA), p. 21. Charles Augustus Young (1834-1908) was an American astronomer and prolific public lecturer with the magic lantern. He taught at Dartmouth from 1865 to 1877, when he moved to Princeton (*Wikipedia*). Benjamin Waterhouse Hawkins (1807-1894) was a British naturalist, sculptor, and artist who created life-size models of extinct reptiles at the Crystal Palace in London. From 1868 to 1876, he spent most of his time in the United States, delivering lectures and participating in skeletal reconstructions of dinosaurs at the American Museum of Natural History in New York and Princeton University (*Wikipedia*). See also: Valerie Bramwell and Robert M. Peck. 2008. *All in the Bones: A Biography of Benjamin Waterhouse Hawkins* (Academy of Natural Sciences, Philadelphia).

36. *Providence Evening Press*, January 20, 1873; *The Daily Critic* (Washington DC), October 28, 1874, p. 1.

37. *Philadelphia Inquirer*, June 8, 1871, p. 2.

38. *Philadelphia Inquirer*, October 19, 1871, p. 2.

39. *Philadelphia Inquirer*, November 4, 1872, p. 2; November 7, 1872, p. 2; March 27, 1874, p. 2.

40. Brian Stevenson. 2017. George Wale, 1840-ca. 1903. http://microscopist.net/WaleG.html

41. *New York Times*, February 24, 1871, p. 8; "The Vertical Lantern," *American Journal of Science and Arts*, July 1871, p. 71, 153-154; Henry Morton, "The Vertical Lantern: a New Instrument of Demonstration," *Chemical News*, August 25, 1871, p. 92; Henry Morton, "The Magic Lantern as a Means of Demonstration, part 2," *Scientific American*, September 20, 1873, p. 184. Brooker (2017) (see note 2) briefly discusses Cooke's role in the development of the vertical lantern.

42. Charles L. Jackson. 1902. Memoir of Josiah Parsons Cooke 1827-1894. *Biographical Memoirs of the National Academy of Sciences* 4:175-183; William B. Jensen. 2011. Physical chemistry before Ostwald: the textbooks of Josiah Parsons Cooke. *Bulletin of the History of Chemistry* 36:10-21.

43. Cooke's Lowell Institute lectures are listed in: Harriette Knight Smith. 1898. *The History of the Lowell Institute* (Lamson, Wolffe and Company, Boston). This book also states that Cooke's vertical lantern was invented for his 1855-1856 lectures (p. 36). See also: J. P. Cooke, Jr. 1871. Magnetism. *Journal of the Franklin Institute* 62:406-412. This article illustrates both Cooke's attachment for converting an ordinary magic lantern to a vertical lantern, and Morton's more refined version. Prof. J. P. Cooke, Jr. 1865. On the projection of the spectra of the metals. *American Journal of Science and Arts*, vol. XL (2nd series) (September 1865):243-248.

44. Harriette Knight Smith (1898) (see note 43) states that "The first course of American lectures illustrated by the stereopticon were those on 'Glaciers,' given by Professor Louis Agassiz at the Lowell Institute, and illustrated for him by Dr. Cooke" (pp. 35-36). This may well be true, as earlier uses of the stereopticon, after the first appearance of the term in 1860, were mostly for stand alone lectures on travel, art, and the Civil War, not courses of lectures on a single topic. See: Kentwood D. Wells. 2011. The stereopticon men: on the road with John Fallon's stereopticon, 1860-1870. *The Magic Lantern Gazette* 23 (3):2-35. A detailed account of the use of a stereopticon in Agassiz's initial glacier

lecture is given in: "How Prof. Agassiz Lectures," *Springfield Republican*, March 25, 1865, p. 4, but does not mention Cooke's assistance. Agassiz had given an earlier set of lectures on glaciers in the 1840s, before the invention of photographic lantern slides; these were illustrated with a large panoramic painting of the Swiss Alps, maps, diagrams, and blackboard drawings. See: "Professor Agassiz," *Portland [Maine] Weekly Advertiser*, March 2, 1847, p. 1.

45. *Providence Evening Press*, January 11, 1870, p. 3. The term "Electric Lights" probably refers to a carbon arc lantern like the one in Fig. 20.

46. *New York Tribune*, April 23, 1873, p. 8.

47. *New York Tribune*, February 16, 1875, p. 12; February 16, 1892, p. 2.

48. "The Optics of Photography," *The British Journal of Photography*, August 25, 1876, pp. 401-404 (reprinted from *Scientific American*).

49. Morton and Edison knew each other well. Edison's Menlo Park laboratory was only about 25 miles from Morton's home in Hoboken. Morton had provided Edison with equipment from the Stevens Institute for some of his experiments, and Edison in turn had presented Morton with one of his phonographs. Both men were among a group of scientists who traveled to Wyoming Territory in 1878 to observe a total solar eclipse. Morton also was present at Edison's demonstration of his light bulb. See: David Baron. 2017. *American Eclipse: A Nation's Epic Race to Catch the Shadow of the Moon and Win the Glory of the World*. For Morton's writing on the history of electric lighting, see: Henry Jackson Morton, "Electricity in Lighting" *Scribner's Magazine* 1889, vol. VI, pp. 176-200. For Morton's lectures on progress in artificial lighting, see*: American Gas-Light Journal*, January 2, 1879, p. 2; February 4, 1889, p. 139; November 6, 1899, p. 726.

50. Jeremy Brooker (2017) (see note 2) has discussed the relationships between Morton and both Pepper and Tyndall in more detail.

51. *New York Tribune*, January 8, 1874, p. 7; January 24, 1874.

Fig. 21. Behind the scenes at Morton's phantasmagoria show. The equipment included a large magic lantern mounted on a platform at the rear of the stage to project background images such as a tunnel entrance, as well as other lanterns mounted on tracks for phantasmagoria and shadow effects. From Sellers and Leeds (1892).

The Research Page presents summaries of recent academic research on topics related to the magic lantern. For a comprehensive bibliography of research articles, see: https://www.zotero.org/groups/magic_lantern_research_group

The Magic Lantern, no. 16 (September 2018).

This issue of the journal of our sister Magic Lantern Society in the U.K. focuses on women and the magic lantern. It includes profiles of several modern female scholars and lanternists, as well as three articles on historical figures. John Hyett, in "Just a Normal Day's Work," (p. 3) briefly describes the work of Sister Edith Greer, an Australian "Bush Nurse," who provided nursing services to remote rural areas in the state of Victoria in the early 20th Century. She also gave magic lantern lectures illustrating and promoting the services of the Victorian Bush Nursing Association. My own article, "As Good as an Hour with Mark Twain: the Medical Lectures of Anna M. Longshore-Potts" (pp. 5-7) discusses another medical practioner who spent more time as a professional magic lantern lecturer than as a practicing physician. One of the first American women to graduate with a medical degree, she soon turned her attention to the promotion of women's health through illustrated public lectures. These included lectures on sex and reproduction "for ladies only," and in at least one case she employed a female projectionist. She also criticized certain practices she considered harmful to women, such as the wearing of tight corsets.

Dr. Anna M. Longshore-Potts

Nele Wynants's article, "Julie and the Grandsart-Courtois Theatre: a Family Affair," (pp. 10-11) tells the story of an extraordinary multi-generational Belgian family of stage musicians and performers, especially Julienne-Reine Courtois, a female physicist and conjurer. In the 1860s, Julie and her family exhibited magic lantern slides of "the most beautiful sights and panoramas known worldwide" to appreciative audiences at fairs in Brussels and Liège, among other cities.

(The Research Page continues on p. 29).

Charles A. Chase and the Electric Cyclorama

Suzanne Wray
252 W. 91st St. #54
New York, NY 10024-1159
gribble@earthlink.net

The late nineteenth century was a world in motion. . . . No matter how impressive the circular panoramas may have been, they were also anomalies; enormous relics from a world that was no more.[1]

At the turn of the century, the panorama became an object of nostalgia and pleasure, something people felt fondness for because it was becoming obsolete.[2]

Despite their artistic value and the great cleverness employed in their construction, the most beautiful panoramas have got beyond the limits of success. Ceding to the taste of the day, one has been converted into a circus, another into a skating rink, and still another into a bicycle track. The invention that we are about to describe in a general way seems destined, if the hopes of the inventor shall be justified, to bring panoramas into fashion again, and to assure them in the future, new success and a less ephemeral existence.[3]

A study of the history of technology shows that there is rarely an unbroken, smooth road to success, although the progression is often portrayed as inevitable, with the most commercially successful invention and its' inventor, being the one remembered. Along the way, there may be many inventions, and some (to use a Darwinian analogy) become "extinct." Elevators were hydraulic, steam, or electrically operated. Early automobiles were operated by steam (the "Stanley Steamer"), electricity, or gasoline. The first automobile fatality recorded was in New York City in 1899 when a man was struck by an electric vehicle, a taxi. We know which technology "won"—was the most widely accepted—in the case of the elevator and the automobile, but for a time several technologies coexisted. Sometimes a better solution is possible: Isambard Kingdom Brunel's broad gauge railroad tracks in England were probably safer and more stable than standard gauge track. But so much standard gauge track had already been laid that Brunel's wider gauge did not succeed. More efficient arrangement of characters on typewriter keyboards have been proposed and tested, but our computer keyboards still have the QWERTY arrangement.

In 1874, the Colosseum opened in New York, on Broadway and 35th Street: in the circular iron building, viewers could see two old panoramas, "London by Day" and "Paris by Night." Building and painting were taken down and re-erected in Philadelphia for the 1876 Centennial Exposition. Twenty years later, Edison's "Vitascope" first showed moving pictures less than two blocks away on 34th Street, at Koster & Bial's Music Hall (Macy's department store is now on the site). This progression from static image to cinema with its' projected moving images is one of those often portrayed as inevitable and inexorable. Of course, it is not that simple: for a time, for example, it was possible to purchase a machine that could show glass slides and film: Lubin's Stereopticon, "suitable for illustrated songs and stereopticon views."[4] This is one invention that became "extinct" (Fig. 1).

LUBIN'S "MARVEL"
CINEOGRAPH
COMBINED WITH
STEREOPTICON.
EXPOSITION MODEL
S. LUBIN, MANFR. PHILA. PA. U.S.A.
EXPOSITION MODEL
This outfit complete including Top and Bottom Rewinder and everything seen on above cut, together with Electric Lamp, Fire-Proof Adjustable Rheostat for direct or alternating Current, also Calcium Light Lamp for Oxygen-Hydrogen Gas or for the Oxylithe Gas Making Outfit. Two Reels, Screw Driver, Oil Can and Film Cement.
The Whole Complete Outfit for $85
We can put AUTOMATIC FIRE SHUTTER and FIRE SHIELDS on this Machine at an Extra Charge of $17.50.

Fig. 1. Lubin's Stereopticon. Free Library of Philadelphia, used with permission.

Often overlooked is the fact that images had "moved" before cinema: Daguerre's diorama gave the illusion of motion in some of the tableaux. The moving panorama was literally a "moving picture"—a long painting—scrolled from one roller to another. And the magic lantern could project moving images: dissolving views, slip slides, chromatropes.

In 1893, the *Chicago Tribune* ran an advertisement for the Chicago Fire Cyclorama (Fig. 2): the "great scene of realistic beauty"—the burning of Chicago in 1871—was to be removed on October 10, and replaced by "one of the most novel, weird, and magnificent exhibitions ever conceived" (Fig. 3).[5]

Fig. 2. Chicago Fire Cyclorama rotunda.

CHICAGO FIRE CYCLORAMA.

ONLY 24 DAYS MORE

—OF THE—

CHICAGO FIRE

CYCLORAMA.

This great scene of realistic beauty, the most wonderful ever presented to the public,

WILL BE REMOVED OCT. 10, 1893,

And will be replaced by one of the most novel, weird, and magnificent exhibitions ever conceived. Full particulars later.

Open Today and Evening | Michigan-av. and Madison-st. COME TODAY. | HOURLY LECTURES.

Fig. 3. *Chicago Tribune,* September 17, 1893. Courtesy of Chicago History Museum.

Almost a year later, in August 1894, the same newspaper printed an article about a "new cyclorama idea" that was to be exhibited in the Chicago Fire Cyclorama rotunda the next week. This would use a battery of ten magic lanterns to project consecutive views of the 1893 Worlds' Fair onto a circular white canvas: the views could be "almost instantaneously" changed by an automatic electric apparatus (Fig. 4).

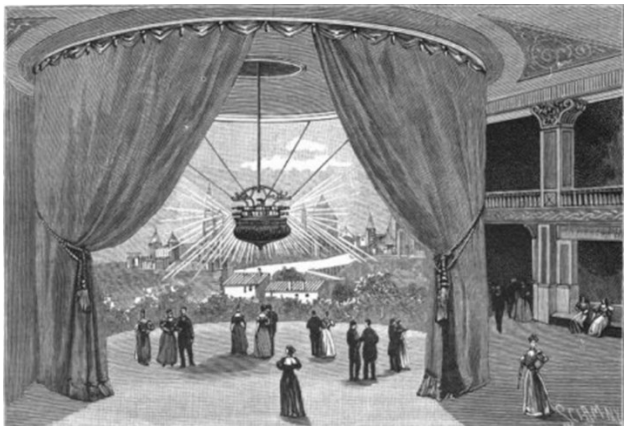


Fig. 4. Chase's Electric Cyclorama. *Photographic Times: An Illustrated Monthly Magazine Devoted to the Interests of Artistic and Scientific Photography*, Vol. XXVI, 1896. Image credited to *Scientific American*.

The stereopticons would be arranged on a chandelier-like platform, which would also hold the single operator (Fig. 5). Dissolving views could be used, and electric light and moonlight effects were said to be possible. (For some reason, this was said to be the invention of B. F. Chase; the father and brother of Charles A. Chase were both named B. F. Chase. All subsequent information lists the name of Charles A. Chase (1857-1925) as the inventor (Fig. 6).

Fig. 5. Chase Electric Cyclorama, operator's platform. *Western Electrician*, Chicago, November 16, 1895.

Fig. 6. Charles A. Chase, *Chronicling America* website.

Several private demonstrations had shown that Chase's idea was workable. The August demonstration was still experimental, a test of the idea, and on a much smaller scale than the plant which Chase planned to build. Reportedly Chase reproduced and enlarged a continuous photograph 4 inches wide and 32 inches long to a "cycloramic picture" 160 feet in length and 15 feet high. Spectators were "surprised and delighted."[6]

In March of the following year, the *Tribune* announced that the Electrical Cyclorama Company had been incorporated with $100,000 capital to promote the invention. Since the demonstration in the cyclorama building, Chase had continued to invent projecting devices and had imported lenses from London: behind each lens would be an electric light-arc light of 4,000 candle power. Now, according to the *Tribune*, the colors of nature could be introduced, and moving figures made to appear in the scenes. The new company was negotiating with the Field Museum of Chicago to present a perpetual panorama of the World's Fair, which would cost $15,000. Foreign views were being taken for future exhibitions.[7]

In August and September 1895 Chase took out patents for a "stereopticon panorama machine", and a "reproducing device" which would hold the lanterns in a spherical space (Fig. 7). A "device" was to be associated with each lantern that would enable the blending or overlap of the edges of each picture without an excess of light being visible at that point. This was critical to ensure that the image seemed to the viewer to be continuous and not a series of images.[8]

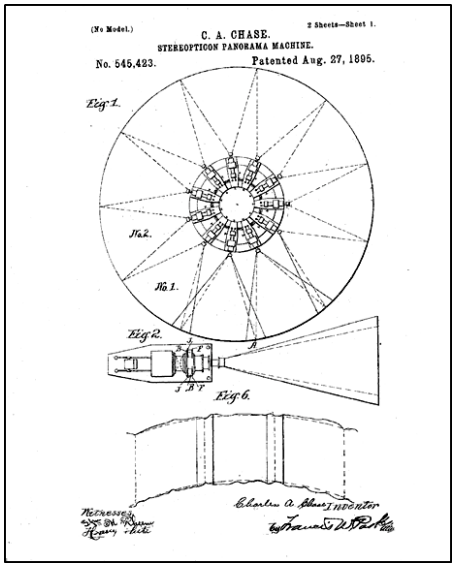
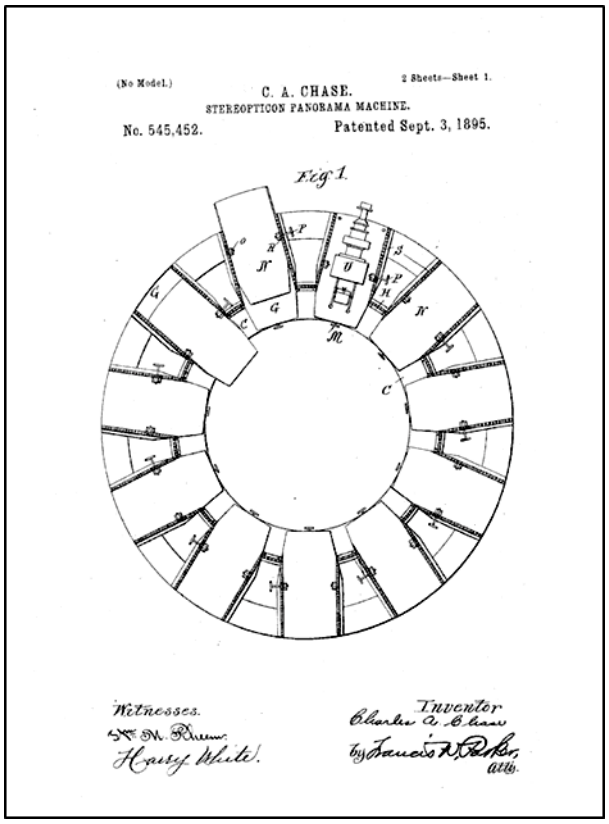

(No Model.) 2 Sheets—Sheet 1.
C. A. CHASE.
STEREOPTICON PANORAMA MACHINE.
No. 545,423. Patented Aug. 27, 1895.
Fig. 1.
Fig. 2.
Fig. 6.
Witnesses.
Inventor

Fig. 7. Charles A. Chase patent drawings for Reproducing Device, Stereopticon Panorama Machine. Google Patents.


(No Model.) 2 Sheets—Sheet 1.
C. A. CHASE.
STEREOPTICON PANORAMA MACHINE.
No. 545,452. Patented Sept. 3, 1895.
Fig. 1.
Witnesses.
Inventor

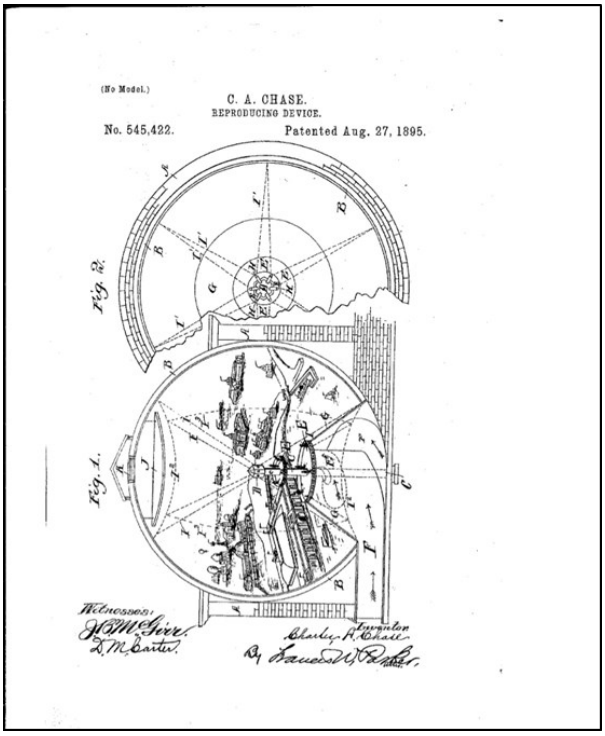

(No Model.)
C. A. CHASE.
REPRODUCING DEVICE.
No. 545,422. Patented Aug. 27, 1895.
Fig. 2.
Fig. 1.
Witnesses:
Inventor

Fig. 7 (continued).

Electrical Engineer published a succinct description of the Chase Electric Cyclorama in November 1895: "By an ingenious combination of arc lamps, fed from rubbing contacts on a circular track suspended from the ceiling of an exhibition room, and an arrangement of especially devised projecting lenses and a continuous photographic film with the necessary mechanisms for blending and adjusting the projected sections of the picture in complete cycloramic view, Chas. A. Chase, a Chicago inventor, has devised the interesting apparatus described."[9]

The Photogram and *Scientific American* were among the publications that printed more detailed articles and illustrations of the "Stereopticon Cyclorama" (Fig. 8). Chase planned to use a spherically shaped building, although he was using a cylindrical screen, the panorama rotunda, as he developed his idea. The screen was to be from 20 to 50 feet high, and 50 to 100 feet in diameter. The operator's platform—one writer called it a "chariot"—was suspended from the ceiling by an iron pipe (which also held the insulated electrical wires) and cable stay wires. It weighed about 800 pounds, was about 8 feet in diameter by 10 feet high. There were now eight lanterns used. Each dissolver worked independently of the other; dissolvers and blending attachments were set with screws. Scenes were changed by an electric switch, and daylight, sunlight, and moonlight effects could be made. Mechanical effects, such moving boats and moving clouds (from real cloud negatives), could appear. These could be done by "the old stereopticon method scientifically improved" or by the use of the kinetoscope. There were no seats for the spectators: as with the circular panorama, they would be able to move about to view the scene, and feel a part of it.

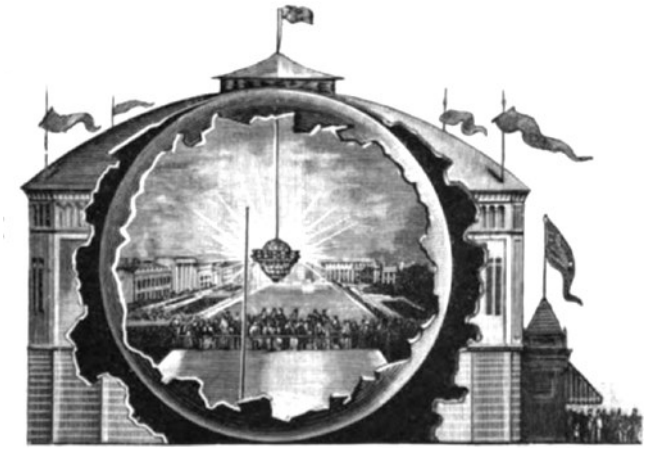


Fig. 8. The Stereopticon Cyclorama. *The Photogram*, January, 1895.

Chase used the Marcellus camera to photograph his slides: this had been invented in 1891 or 1892 and was specifically designed to capture 360 degree views (Fig. 9). The photographic film was 7 feet long and eight inches high; this was used to produce transparencies that could produce a picture 300 feet in circumference and 35 feet high. When the scenes were projected, "the floor upon which the spectators stand runs right off into the scenes, and it is so real that it seems as if we could step right out into the country viewed." With this, Chase echoed one of the clichés about the circular painted panorama: it was almost impossible to tell where the foreground ended and the painting began. The images were colored by the "Nature Process," invented by David P. Breed of Pittsburgh: I have not been able to discover anything about this process.[10]

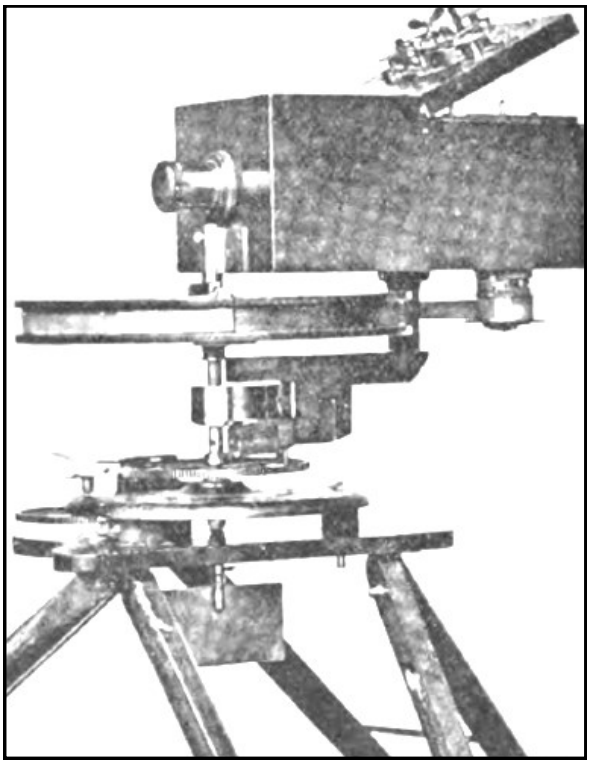


Fig. 9. Marcellus cyclorama panoramic roll camera. http://www.historiccamera.com/

A widely reprinted newspaper article portrayed Chase "as Edison's rival" with the cyclorama showing "figures on canvass that walk and talk." "Everything will be in motion as in life." Reportedly Chase had worked daily for twelve years, using 12 lanterns (note the varying number of lanterns in the different accounts). The kinetoscope would reproduce the movement of the crowds in the World's Fair scenes, and the noise of the crowd and fireworks would be produced by a new phonograph attachment by Edison. Although published accounts always mentioned the proposed use of the kinetoscope to enhance the exhibition, I have found no evidence that it, or the phonograph, was ever actually used. [11]

One of the advantages of Chase's electric cyclorama over the painted panorama was to be the cost: it would be cheaper than commissioning a group of artists to paint one of the huge circular paintings. The anticipated conversion of an ordinary panorama building to an "electric cyclorama" by merely painting the back canvas white for use as a screen, and suspending the operators' platform, would keep down the cost.

The *British Journal of Photography* doubted this: "The apparatus is as ingenious as it must be costly, but we much doubt the commercial success of the scheme, especially at the present time, when, judging from provincial and other accounts, the public seems to be surfeited with lantern shows."[12] The *Journal* apparently failed to realize how Chase's concept differed from the traditional "lantern show."

There were challenges to Chase's claim to invention. John Winter (1825-1906), a German artist in Syracuse, New York, published his version of the stereopticon cyclorama two months after Chase's version appeared in the *Optical Magic Lantern Journal* (neither Winter nor Chase is given full credit for the invention). [13] In Paris in March 1892, inventor Colonel Moessard was said to have projected panoramic lantern slides on a semicircular canvas. An 1896 magazine article reported that Moessard "suggested" rather than demonstrated the idea.[14] And a patent was granted to a J. Train in August of 1894, for a series of magic lanterns to be mounted on a stationary or revolving platform to throw scenes onto a polygonal or curved white screen. Other lanterns would be mounted below the platform to light the foreground (Fig. 10).[15]

In May 1895, the *Daily News* of Champaign, Illinois, published an article on the "Future of the Panorama." Chase's cyclorama is obviously the basis for the description of the "future" panorama, though there are embellishments:

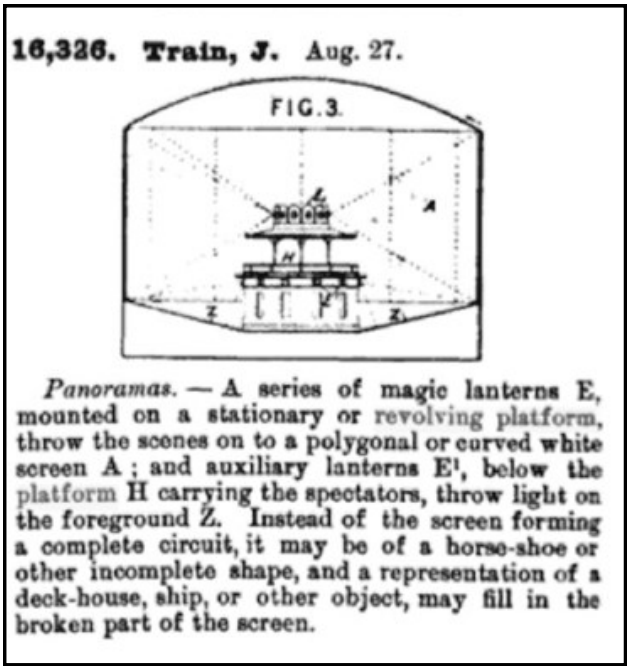

16,326. **Train, J.** Aug. 27.

FIG. 3.

Panoramas. — A series of magic lanterns E, mounted on a stationary or revolving platform, throw the scenes on to a polygonal or curved white screen A; and auxiliary lanterns E¹, below the platform H carrying the spectators, throw light on the foreground Z. Instead of the screen forming a complete circuit, it may be of a horse-shoe or other incomplete shape, and a representation of a deck-house, ship, or other object, may fill in the broken part of the screen.

Fig. 10. Train's patent, 1894. *Patents for Inventions*, 1899.

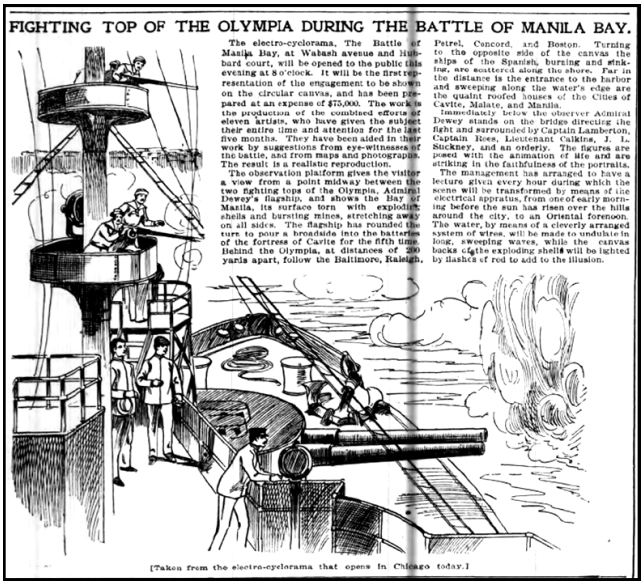
> A prepared wall, lining a cylindrical chamber, is all that is required as a permanent plane. Upon this wall pictures are thrown after the fashion of stereopticon views. The apparatus occupies a circular table attached to the upper rim of a round box-shaped receiver, in the middle of which the operator stands. The table is readily revolved, and has sets of projectors, lanterns, kinetoscopes, kinematographs, and other necessary arrangements. Vanishing effects and tones of all grades, from the brightest to the most shadowy, are at hand. With this equipment it is possible to picture the march of an army, the movements of animals and vehicles, or the antics and pranks of human beings, moonlight effects, naval battles, ships in motion, and all of the various scenes of life can be accurately depicted.[16]

One wonders how the operator of this apparatus coped with handling the various pieces of equipment while the circular table on which he was standing revolved!

By 1896, the Chase cyclorama was said to be "in a fair way of becoming an accomplished fact upon a large scale." Two years later, Charles A Chase became president of the new Chase Electric Sign Company of Chicago, organized to meet the demand for electrically illuminated signs and street advertising

designs. The announcement wrote that Chase "also has a taste for photography and electrical projection, being the inventor of the very interesting Chase electric cyclorama . . . which has attracted considerable attention at home and abroad."[17]

That same year, 1898, the "electro-cyclorama" of the Battle of Manila Bay opened in Chicago (Fig. 11). A circular painting, it was the work of eleven artists and five months, done at a cost of $75,000. Electricity was used to give the illusion of motion, and sound: the stillness and silence of cycloramas, especially those of battle scenes, always had been commented upon. Light changed from dawn to forenoon; waves were simulated by "a cleverly arranged system of wires", and flashes of red appeared when shells exploded, the sounds of guns were heard.[18] Magic lanterns may have been used for some of the effects, and perhaps some of Chase's devices? His own Electric Cyclorama, however, had faded away.



FIGHTING TOP OF THE OLYMPIA DURING THE BATTLE OF MANILA BAY.

The electro-cyclorama, The Battle of Manila Bay, at Wabash avenue and Hubbard court, will be opened to the public this evening at 8 o'clock. It will be the first representation of the engagement to be shown on the circular canvas, and has been prepared at an expense of $75,000. The work is the production of the combined efforts of eleven artists, who have given the subject their entire time and attention for the last five months. They have been aided in their work by suggestions from eye-witnesses of the battle, and from maps and photographs. The result is a realistic reproduction.

The observation platform gives the visitor a view from a point midway between the two fighting tops of the Olympia, Admiral Dewey's flagship, and shows the Bay of Manila, its surface torn with exploding shells and bursting mines, stretching away on all sides. The flagship has rounded the turn to pour a broadside into the batteries of the fortress of Cavite for the fifth time. Behind the Olympia, at distances of 200 yards apart, follow the Baltimore, Raleigh, Petrel, Concord, and Boston. Turning to the opposite side of the canvas the ships of the Spanish, burning and sinking, are scattered along the shore. Far in the distance is the entrance to the harbor and sweeping along the water's edge are the quaint roofed houses of the Cities of Cavite, Malate, and Manila.

Immediately below the observer Admiral Dewey stands on the bridge directing the fight and surrounded by Captain Lamberton, Captain Rees, Lieutenant Calkins, J. L. Suckney, and an orderly. The figures are posed with the animation of life and are striking in the faithfulness of the portraits.

The management has arranged to have a lecture given every hour during which the scene will be transformed by means of the electrical apparatus, from one of early morning before the sun has risen over the hills around the city, to an Oriental forenoon. The water, by means of a cleverly arranged system of wires, will be made to undulate in long, sweeping waves, while the canvas backs of the exploding shells will be lighted by flashes of red to add to the illusion.

[Taken from the electro-cyclorama that opens in Chicago today.]

Fig. 11. Chicago *Tribune*, December 19, 1898. www.fultonhistory.com/Fulton.html

Others continued to work at projecting images, still or moving, onto the inside wall of a circular building. At the 1900 Paris World's Fair, the Cinéorama of Raoul Grimoin-Sanson used 10 synchronized movie projectors to project a simulated balloon journey (Fig. 12). The viewing platform was a large balloon basket that could hold 200 spectators; they viewed scenes from various European countries that had been filmed from ground level. But the balloon basket was placed upon the unventilated circular projection booth and the heat generated by the projectors created a fire hazard: the attraction was closed by the police after a few days.[19]

Fig. 12. Projection apparatus for the Cinéorama, now at the Musée des Arts et des Métiers. Photo by Gabriele Koller.

A search on the Internet reveals many, many other 19th, 20th, and 21st century attempts at projecting images into a circular space. [20]

In 2013, artist T. J. Wilcox exhibited his installation "In the Air" at New York's Whitney Museum (Fig. 13). This was described as "a remarkable new panoramic film installation. . . . Here Wilcox revisits the "cinema-in-the-round" that appeared at the dawn of film history in the late 19th century, bringing the concept up to date with state-of-the-art technology to create an immersive cinematic environment"[21] Images of the installation show an uncanny similarity to those of Chase's Electric Cyclorama. A circular screen about 7 feet high and 35 feet in diameter was suspended from the ceiling, hanging about 4 ½ feet above the floor.[22] Viewers were free to move about the installation, standing inside the circle or outside to watch a filmed, sped-up panorama of Manhattan from sunrise to nightfall shot from the artists' studio above Union Square. From time to time, one of six historic films on a New York-related topic would be projected on a section of the screen; these were subtitled. There was no music or narration involved. I saw the installation and wondered if T. J. Wilcox knew of the magic lantern and the attempts of Charles Chase and others to project images into a circular space.

Fig. 13: "In the Air" exhibition at the Whitney Museum in 2013.
http://collabcubed.files.wordpress.com/2013/10/t-j-cox_in-the-air_whitney_panormic-filminstallation-nyc_3_collabcubed.jpg

Notes and References

1. Erkki Huhtamo. 2013. *Illusions in Motion. Media Archaeology of the Moving Panorama and Related Spectacles* (The MIT Press, Cambridge, Massachusetts).

2. Bernard Comment. 1999. *The Panorama*, trans. Anne-Marie Glasheen (Reaktion Books, Ltd., London), p. 257.

3. "Chase's Electric Cyclorama," *The Photographic Times: an Illustrated Monthly Magazine Devoted to the Interest of Artistic and Scientific Photography*. Volume XXVIII, 1896, pp. 200-201.

4. Advertisement for Lubin's Stereopticon. Free Library of Philadelphia, with many thanks to Will Echevarria, Digital Collections Curator.

5. Advertisement for Chicago Fire Cyclorama, *Chicago Daily Tribune*, September 17, 1893, https://www.greatchicagofire.org/item/cyclorama/. For those not familiar with the panorama, it was a huge circular painting that surrounded the viewers; today it is often called a precursor to "virtual reality." Cyclorama was the name often used in the United States.

6. "New Cyclorama Idea," *Chicago Tribune*, August 16, 1894, https://chicagotribune.newspapers.com/

7. "To Promote Chase Cyclorama," *Chicago Tribune*, March 11, 1895, https://chicagotribune.newspapers.com/

8. "Reproducing Device," and "Stereopticon Panorama Machine," *The Photographic Times an Illustrated Monthly Magazine Devoted to the Interest of Artistic and Scientific Photography*. Volume XXVII, November 1895, p, 318.

9. "Chase Electric Cyclorama," *Western Electrician*, November 16, 1896, Vol. XVII, No. 20, p, 235.

10. "The Stereopticon Cyclorama," *The Photogram*, January, 1895, Volume 2, No. 13, pp. 91-92.

11. "Charles A. Chase, A Chicago inventor Who Bids Fair to Rival Edison," *Pioneer Express,* Pembina, North Dakota, June 14, 1895. Chronicling America, https://chroniclingamerica.loc.gov/lccn/sn88076741/1895-06-14/ed-1/seq-1

12. *British Journal of Photography*, 1895, quoted in http://widescreenmovies.org/WSM01/history.htm

13. Thomas Hunter, "John Winter: The German Artist of Syracuse, New York," *The Central New York Business Journal,* December 13, 2013, p. 68. Charles A. Chase, "Stereopticon Cyclorama." *Optical Magic Lantern Journal,* vol.6, p. 70 (March 1895). John Winter, "Stereopticon Cyclorama." *Optical Magic Lantern Journal,* vol.6, p. 72 (May 1895).

14. "A Photographic Cyclorama," *Cassell's Family Magazine*, London, England, 1896, p. 508.

15. "16, 326. Train, J. Aug. 27," *Patents for Inventions: Abridgements of Specifications*, 1894, p. 128.

16. "Future of the Panorama," *The Champaign Daily News*, May 9, 1896, Illinois Digital Newspaper Collections.

17. *Western Electrician*, Volume 22, April 9, 1898, p. 219.

18. "Fighting Top of the Olympia During the Battle of Manila Bay." *Chicago Tribune*, December 19, 1893. http://fultonhistory.com/Fulton.html

19. Huhtamo 2013 (see note 1), pp. 317-318.

20. Two such sites:

http://widescreenmovies.org/WSM01/history.htm

http://www.kwiatek.krakow.pl/publications/20120927_360storytelling_

21. https://whitney.org/Exhibitions/TJWilcox

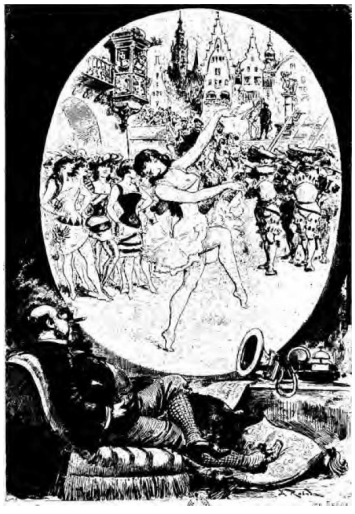
22. Roberta Smith, "Living a Day in Half an Hour, 'T.J. Wilcox: In the Air,' at the Whitney Museum." http://www.nytimes.com/2013/09/20/arts/design/t-j-wilcox-in-the-air-at-the-whitney-museum.html

Ian Christie. 2016. The stuff of screens, pp. 70-79. In: Dominique Chateau and José Moure, eds. *Screens*. Amsterdam University Press, Amsterdam, Netherlands. (Chapters of this book can be accessed online through JSTOR).

Ian Cristie reviews the history of screen technology for projected images from the magic lantern to the cinema. Among the topic covered are rear screen projection, as with the phantasmagoria, and front screen projection for most magic lantern shows and lectures, and for the cinema. He also discusses ways in which screens were framed in theaters, the use of curtains to hide the screen before the show, and both screen and image shape. Much of this will be familiar to readers of the *Gazette*, but the chapter serves as an introduction to screen technology for readers of a multidisciplinary book on actual and metaphorical screens.

José Moure. 2016. Archaic paradigms of the screen and its images, pp. 42-61. In: Dominique Chateau and José Moure, eds. *Screens*. Amsterdam University Press, Amsterdam, Netherlands.

José Moure takes a more expansive view of screens, both real and metaphorical, from the images on the walls of Plato's cave and Narcissus staring at his reflected image in water to the phantasmagoria and cinema. Discussions of real screen experiences, such as phantasmagoria shows, are interspersed with literary references to screen images from ancient mythology to 19th century science fiction stories and Albert Robida's fictional telephonoscope home theater, discussed in detail in a previous article in the *Gazette* [Fleur Hopkins. 2016. Albert Robida's visions of future time: the magic lantern turned into a magic mirror. *The Magic Lantern Gazette* 28(1):3-18].



Albert Robida's imagining of a telephonoscope for home use.

Jane Lydon. 2017. Charity begins at home? Philanthropy, compassion, and magic lantern performances in Australasia, 1891-1892. *Early Popular Visual Culture* 15:479-499.

Jane Lydon describes the magic lantern tours of two missionaries in Australia and New Zealand in the early 1890s. Alfred Burton, who represented the London-based charity Bernardo's orphanages in the Australian colonies, focused his magic lantern fundraising tours on poor urban children, most of whom were white. He used "before and after" photos, some of them obviously posed, to depict homeless or neglected children in comparison to those receiving care and education through the orphanages. He was successful in using lantern slides to appeal to the emotions of viewers, thereby raising considerable sums of money for the charity. In contrast, Australian missionary John Brown Gribble used lantern slides to illustrate the plight of aboriginal peoples confronted with the ever advancing waves of white settlers pushing their way into the hinterlands of the continent. He also showed "before and after" images comparing "wild" blacks with those living in missionary settlements. Gribble met with a much less positive response from his mainly white audiences, whose attitudes toward aboriginal people ranged from indifference to outright hostility, many viewing these people as a hindrance to advancing civilization.

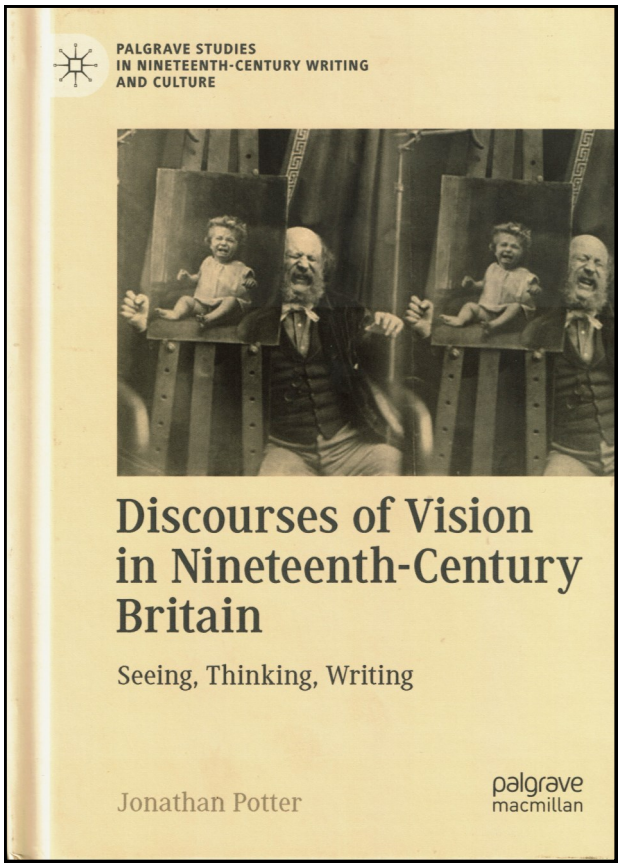
***The Magic Lantern*, no. 17 (December 2018).**

The latest issue of *The Magic Lantern* arrived just as this issue of the *Gazette* was being completed. It is an unusually rich one, with a variety of contributions and an abundance of color illustrations. Two research articles continue the focus of the previous issue on women and the magic lantern. In "A late developer—Isabella Bishop FRGS," (pp. 4-5) David Cozens tells the remarkable story of Isabella Bird Bishop (1831-1904), an intrepid world traveler and writer who became a magic lantern lecturer relatively late in life and was one of the first women elected a Fellow of the Royal Geographical Society. Her early travels took her to the United States, Canada, Hawaii, New Zealand, and Australia and resulted in several published travel books. As she got older, she became more adventurous, traveling to exotic locations such as the Atlas Mountains of Morocco, Japan, China, and Central Asia, including a 600-mile overland trip through China to Tibet. Taking her own photographs which she developed in makeshift darkrooms along the way, she built a large collection of lantern slides for use in her lectures. Several of those slides are reproduced in this article.

Another female lantern lecturer is discussed by Steven Anderson in "Muriel Matters and magic lanterns" (p. 14). Muriel Matters was born in Australia in 1877, but spent much of her life in England. When she moved to England in 1905, most Australian women had the right to vote, but those in England did not. Matters became an advocate for women's suffrage and engaged in demonstrations for women's rights. In 1910, she returned to Australia for a lecture tour addressing women's rights, prison reform, and other social issues, using lantern slides supplied by the London newspaper *Daily Mirror*. She later returned to England, where she had a long career as a lecturer, journalist, educator, and actress until her death in 1969.

Richard Crangle has a long research article not related to women and the magic lantern, "Some lesser-known life model slide makers. No. 2—W. Rider & Co. of London" (pp. 8-11). He gives a detailed account of the history of this little-known firm, including tips on how to recognize the company's slides, which usually are unmarked. These include characteristic design features of title slides, the repeated use of certain items in stage sets for various slide sets, and the use of the same models for different sets, including a man thought to be Mr. Rider himself. The article is generously illustrated with full color examples of Rider life-model slides.

Other features in this issue include an account of different slides used in lantern performances of *Gabriel Grub* (from *The Pickwick Papers* by Dickens), including a set by American political cartoonist Thomas Nast (Else Flim and Adrian Kok, p. 1, 3); a short piece by Sergi Arnalot (Sergi Buka) on sources for early phantasmagoria slides in a 17th century print by Jacques Callot (p. 6); two short articles by Lester Smith on magic lantern images in the American periodical *Youth's Companion* and the British *Daily Graphic* (p. 7, 17); illustrations of a story slide set, "A Suffragette Tale" from Lester Smith (p. 15); another in a seemingly inexhaustible supply of articles by Bill Barnes, this one on "Bilderbogen peepshow views, transparencies and Vues d'Optique" (ppp. 12-13); and illustrated accounts of two highly successful 2018 magic lantern meetings in Australia and in Birmingham, England, the latter featuring mostly female presenters.



Jonathan Potter. 2018. *Discourses of Vision in Nineteenth-Century Britain. Seeing, Thinking, Writing*. Palgrave MacMillan, London. ISBN 978-3-319-89736-3. 269 pages. $84.99 (cheaper on Amazon).

This is a scholarly book aimed mostly at other scholars, but has much to offer other readers with an interest in the cultural impact of the magic lantern and other optical devices. The first six chapters will be of most interest to general readers; the remaining chapters become more theoretical and less accessible to non-academic readers. After an introductory chapter that sets the framework for the book, the author discusses the place of the panorama in Victorian culture and its influence on "panoramic writing," such as sketches describing the passing scene of urban life. Next he tackles the magic lantern and its use as a metaphor for views from a balloon flight, as well as dreams and reveries. These metaphors overlap to some extent—the views from a train window were sometimes described as similar to magic lantern views, but could equally apply to the experience of a moving panorama. Other chapters deal with dissolving views, the stereoscope, photography, and the science of vision, both as optical phenomena and optical metaphors in literature.—**The Editor**.

SEASON'S GREETINGS

Above: Portrait of Henry Morton as President of the Stevens Institute of Technology, with his vertical magic lantern. From Sellers and Leeds (1892).

Front cover: Photograph of the solar eclipse of 1869 taken by Henry Morton's photographic expedition to Ottumwa, Iowa. https://graphicarts.princeton.edu/2016/05/24/1869-eclipse-photographed/